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Energy Elasticity on Heterogeneous Hardware using Adaptive Resource Reconfiguration

(Invited Demonstration)

Annett Ungethüm[1], Thomas Kissinger[1], Willi-Wolfram Mentzel[1], Eric Mier[1], Dirk Habich[1], Wolfgang Lehner[1]

Energy awareness of database systems has emerged as a critical research topic, because energy consumption is becoming a major factor. Recent energy-related hardware developments tend towards offering more and more configuration opportunities for the software to control its own energy-based behavior. Existing research within the DB community so far mainly focused on leveraging this configuration spectrum to identify the most energy-efficient configuration for specific operators or entire queries. In [Un16], we introduced the concept of energy elasticity and proposed the energy-control loop as an implementation of this concept. Energy elasticity refers to the ability of software to behave energy-proportional and energy-efficient at the same time while maintaining a certain quality of service.

Within our demonstration we employ an ODROID-XU3, which is based on the ARM big.LITTLE design. The chip features one cluster of four LITTLE ARM Cortex A7 (frequency range from 200MHz to 1.4 GHz) and one cluster of four big ARM Cortex A15 (frequency range from 200MHz to 2 GHz). Thus, the chip allows 24 active core combinations and 247 frequency combinations (100 MHz steps; shared clock per core cluster) which amounts to a total configuration space of 5,928 exploration points. The ODROID-XU3 also contains four current and voltage sensors. They are used in our demo for individually measuring the power consumption of the A15 and A7 cluster as well as the DRAM.

The demo software itself runs a basic storage subsystem allowing memory-intensive as well as compute-intensive tasks. The user is able to interactively adjust the workload in terms of overall system load, task mix, and desired query latency. Then, our energy-control loop automatically selects one out of 5,928 chip configurations and applies the configuration at runtime to implement our energy-elasticity. Furthermore, the monitoring information is gathered from the system and is visualized in the demo UI.

References

[Un16] Ungethüm, Annett; Kissinger, Thomas; Mentzel, Willi-Wolfram; Habich, Dirk; Lehner, Wolfgang: Energy Elasticity on Heterogeneous Hardware using Adaptive Resource Reconfiguration LIVE. In: SIGMOD. pp. 2173–2176, 2016.

[1] Technische Universität Dresden, Dresden Database Systems Group, 01069 Dresden,
<firstname>.<lastname>@tu-dresden.de