Research Topics for Senior Projects 2018

Hitoshi Oi
The University of Aizu

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CAOS

Computer Architecture and Operating Systems Group
We are mostly working in the shaded layers
Research Interests in General

Hardware/Software Interaction and Co-Design

• How modern (& realistic) software accesses hardware components?

• How modern computer systems are designed and how they can be better utilized?

Primary Metrics

• Performance: How many tasks (or much work) can be finished in a fixed amount of time?

• Energy-efficiency: How can we reduce the energy consumption for the same amount of work?
Topics of Recent Students (1)

Security in Internet of Things

• Things that used to work stand-alone are now connected each-other and accessible over the Internet

• For example, electrics appliances are connected to the Internet and collect information; you can check the stock of your fridge and make (semi)-automatic order of missing items.

• On the other hand, they can be security holes:
  – These ‘things’ look like ordinary electric appliances and don’t seem to require security protection
  – Due to the price (& other) restrictions, resources are limited (e.g. CPU, power supply); methodologies for resource-rich devices may not be applicable (e.g. encryption).
μ-architecture Effect on Performance and Power

- x86 (desktop and servers) and ARM are two most dominant CPU architectures.

- *Basically*, programs written for an architecture should run on any platforms on the same architecture (binary compatibility).

- However, there are many different hardware-implementations of the same architecture (microarchitectures), which result in variations in the performance and power consumption.

- A student studied the effect of microarchitectures using a standard benchmark programs.
Suggested Research Topics (1)

Linux File Systems

- File systems store various and huge amount of information, such as programs, user data, system configuration.

- In addition to the increasing capacity (amount of stored information), various requirements are emerging: speed (latency and throughput), reliability, flexibility, …

- Study the designs of current file systems and identify the issues for further improving the file systems.

- Study the types and characteristics of the workload against file systems.
Inter-Domain Communication in Virtualized Systems

- Multiple independent “machines” can be accommodated on a single platform (virtual machines, VMs, or domains).
- When multiple VMs form a large system (multi-tier system), communication between VMs takes place.
- Inter-domain communication goes through different paths than that of physical machines (NIC, network switch, LAN cable..)
- Investigate the inter-domain communication overhead, and relate it to the behavior of the applications and configurations of the VMs.
Suggested Research Topics (3)

Hardware Acceleration of Java Virtual Machine

- Java programs (source files) are compiled into an abstract machine instructions, Java Bytecodes.

- The, Java Bytecodes are either interpreted or compiled by the CPU of the system executing the Java application (Java Virtual Machine, or JVM).

- JVM has advantages, such as platform independence, but some operations are inefficient.

- With a programmable hardware platform (e.g. FPGA), we can design a module to which inefficient operations can be offloaded.
Heterogeneous Multi-Core Systems

- Multi-core CPUs are ubiquitous: even your smart phones should have dual or quad-core CPUs.
- Also, in addition to the main (general-purpose) CPUs, GPUs are included for faster-graphic processing.
- Another type of multi-core CPUs are emerging: heterogeneous-microarchitecture. Example of commercial product: ARM big.LITTLE.
- Cores have the same ISA ($\approx$ can run the same machine code programs), but implementations are different. The difficult (but worth investigating) part is how to assign a right job to a right core.
References

- Group Website: http://www.oslab.biz, follow links to Public Area for the these of past students

- Open Campus website: http://opencampus.oslab.biz; a bit old but written in plain Japanese for general public.

- Research page: http://www.u-aizu.ac.jp/~hitoshi/RESEARCH/publication and other research activities.

- Posters outside the lab (Research Quadangles 241-E).

QR Codes for above pages