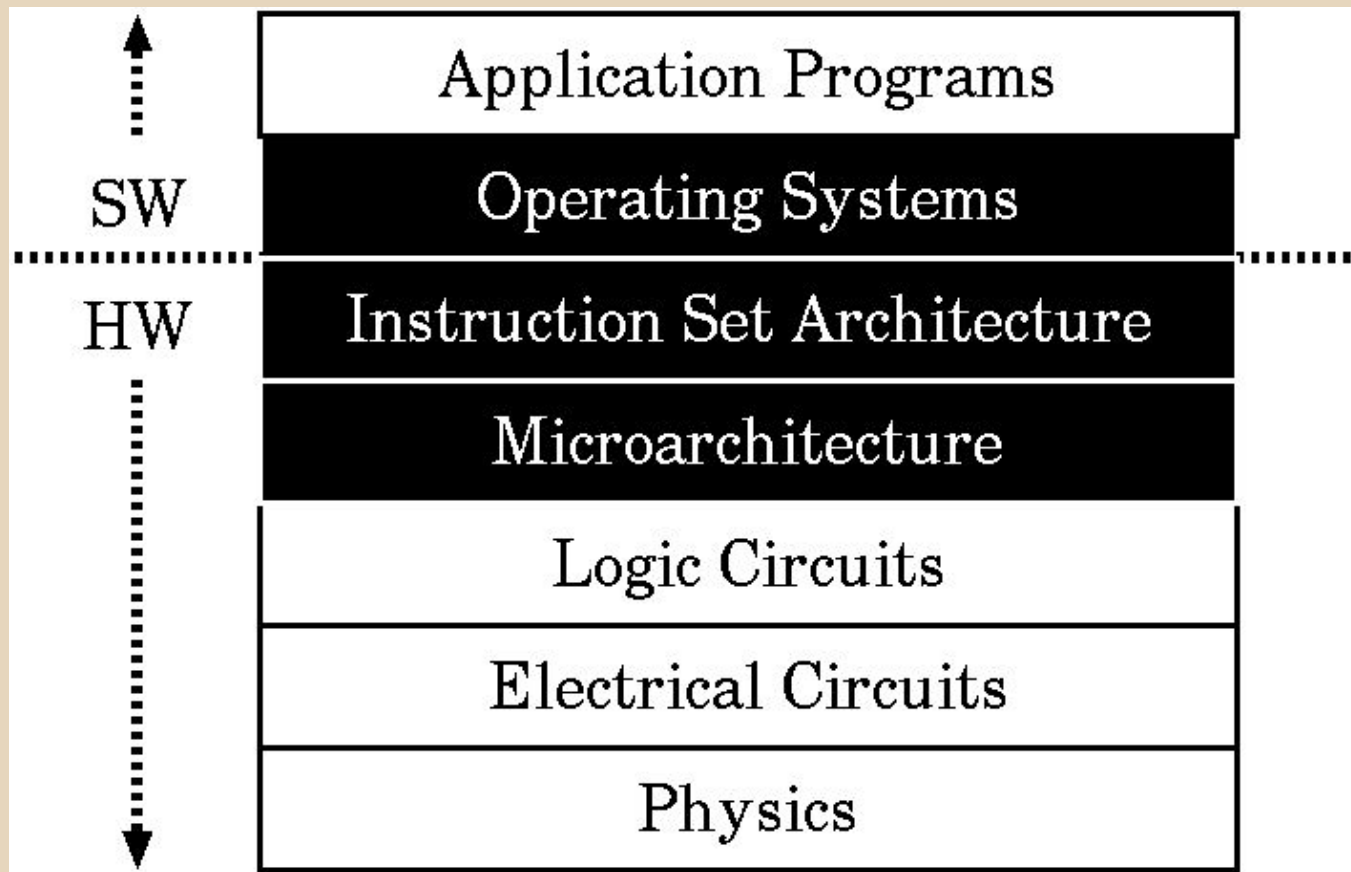


Research Topics for the Senior Projects (for the current Sophomores)



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October 30, 2024.

Computer Systems Abstraction Layers



We are mostly working in the white on black 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 ?

Suggested Research Topics (1)

Edge AI Chips

- perform inferences using pre-trained models at the edge (eg surveillance camera).
- Commercial chips available include: Google Coral TPU and RK3399Pro (and many others)
- The above (pre-)training requires high-performance and power-hungry GPUs in a data center, while edge AI chips are only for inference, with limited resources (eg. storage, data types)
- However, some types of model training can be done with the edge AI chip (few shot training); aim to improve the performance/accuracy of such training in this topic.

Suggested Research Topics (2)

Heterogeneous Multi-Core CPUs

- Differences in microarchitectures* result in various implementations of a single instruction set architecture.
- *Examples: #pipelines, sizes and levels of caches
- Some chips combine high-performance and power-efficient cores: processes migrate according to the workload characteristics.
- Arm has been selling as big.LITTLE now calling it as DynamIQ. Intel's next generation Core (Alder Lake) also has this architecture. (and now AMD has Zen4c).
- Process/thread scheduling in such architectures can be your research topic.

Suggested Research Topics (3)

RISC-V: Free and Open-Source Standard Architecture

- System designers integrate necessary functions with CPU and implement them on a chip (SoC).
- For the CPU part, Arm has been dominant in the market, meaning they have to pay license fee to Arm.
- RISC-V is expected to eat the share of Arm, because it is free and open-standard ISA.
- A sample topic: implement specialized operations (eg signature checking) and integrate them as extended instruction. Estimate their effectiveness (in metrics on page 3)
- OS, boards, HDL models, dev. tools available now.

Expectations to Students

- Communication: don't need to be eloquent but responsive (email used as the primary means of communication)
- Decent overall academic record and good one in your area of interests
- Don't hate reading English documents
- Familiarity to Linux and system admin/management (beyond what you do in the 'exercise' classes); or willing to learn them.
- Please contact by email (hitoshi@u-aizu.ac.jp) for personal discussion (or any inquiry).
- Posters used in the Open Campus last year are at opencampus.oslab.biz