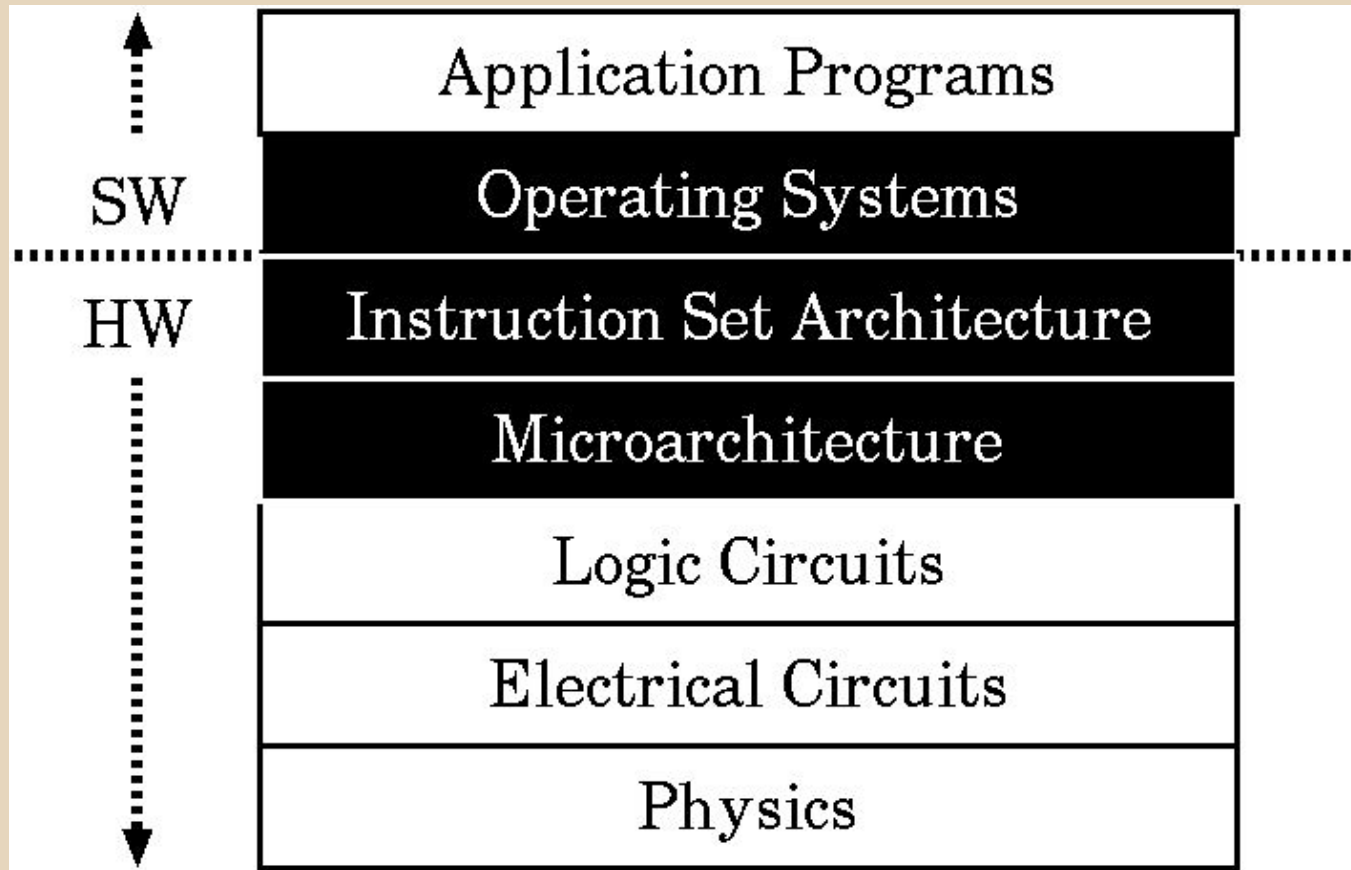


# Research Topics for the Senior Projects (for the current Sophomores)



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# 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 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.
- Process/thread scheduling in such architectures can be your research topic.

# Suggested Research Topics (3)

## RISC-V: Free and Open-Source 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-source ISA.
- A sample topic: implement specialized operations (eg signature checking) and integrate them as extended instruction. Estimate their effectiveness
- 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](mailto:hitoshi@u-aizu.ac.jp)) for personal discussion (or any inquiry).