Term Project

Every student must complete a term project. Teamwork is encouraged. Each team can have at most three students. You are responsible for defining your own project. Your project can be either a survey or an implementation study. The project must have a fairly significant piece of work. Students are encouraged to take on projects that involve experimental efforts or proving new results (or both). Survey papers should be considered an option of last resort --- if you take this option, your survey paper should be fairly extensive. It would also be much preferable to survey research that is more "cutting edge" rather than work from 10 or 20 years ago.

**Project areas:**

* Processor, memory, and storage systems architecture
* Parallelism: instruction, thread, data, multiprocessor
* Datacenter-scale computing
* IoT, mobile, and embedded architecture
* Interconnection network, router, and network interface architectures
* Architectures for emerging applications including machine learning and bioinformatics
* Architectural support for programming languages or software development
* Architectural support for interfacing with accelerators
* Architectural support for security, virtual memory, and virtualization
* Dependable processor and system architecture
* Architectures for emerging technologies including novel circuits, memory technologies, quantum computing, etc.
* Architecture modeling, simulation methodologies, and tools
* Evaluation and measurement of real computing systems
* ...

Project Proposal

Write a short proposal, one or two paragraph (about 1-page single column, not special format requirement) that describes your project, what you aim to accomplish, and the motivation behind your choice of project.

Submission

Submit the proposal (WORD or PDF) by October 22.

One per group submit to CANVAS.

**1. Performance Optimization of SSDs using Hybrid Storage Systems**

* **Objective**: Investigate the performance gains of hybrid storage systems that combine SSDs with traditional HDDs or NVM (non-volatile memory). Explore techniques such as tiered storage, caching algorithms, or intelligent data placement to optimize performance.
* **Motivation**: As SSDs continue to replace HDDs, hybrid storage systems could provide a balance between speed and cost. This project could investigate real-world applications that benefit from this combination.

**3. Study of SSD Performance Bottlenecks in Datacenters**

* **Objective**: Survey or implement an analysis of how SSDs behave under high load in datacenters, focusing on identifying performance bottlenecks such as I/O contention or garbage collection issues.
* **Motivation**: With the growing use of SSDs in cloud and datacenter environments, understanding bottlenecks and proposing potential solutions could have a significant impact on improving system performance.
* Wear-leveling algorithm optimization:
  + Objective: Develop an improved wear-leveling algorithm for SSDs.
  + Aim: Extend SSD lifespan by more evenly distributing write operations across all memory cells.
* Hybrid storage system:
  + Objective: Design a storage system that combines SSDs and HDDs.
  + Aim: Maximize performance and capacity while minimizing cost in large-scale storage systems.
* SSD controller architecture analysis:
  + Objective: Compare different SSD controller architectures.
  + Aim: Determine the impact of controller design on overall SSD and system performance.
* Novel garbage collection strategy:
  + Objective: Implement a new garbage collection algorithm for SSDs.
  + Aim: Improve SSD write performance by optimizing the process of reclaiming space from invalid data.
* Emerging SSD technologies support:
  + Objective: Explore architectural support for new SSD technologies like 3D NAND or QLC.
  + Aim: Identify and address potential performance bottlenecks in systems using these new technologies.
* NVMe SSDs in datacenters:
  + Objective: Analyze NVMe SSD performance in datacenter environments.
  + Aim: Quantify the benefits and potential challenges of widespread NVMe adoption in large-scale systems.
* ML-based predictive maintenance for SSDs: Objective: Develop a machine learning model for SSD health prediction. Aim: Improve datacenter reliability by predicting SSD failures before they occur.
* SSD-based swap space analysis: Objective: Investigate the impact of using SSDs for swap space. Aim: Determine the performance benefits and potential drawbacks of SSD-based swap in memory-constrained systems.
* SSD-specific data compression: Objective: Implement a new data compression technique optimized for SSDs. Aim: Increase effective SSD capacity and potentially improve performance through reduced data transfer.
* SSD security enhancements: Objective: Analyze SSD security vulnerabilities and propose architectural improvements. Aim: Enhance data protection in SSD-based systems without significantly impacting performance.