Computer Science 3344 Computer Architecture

Student Learning Outcomes

1. Students will understand how computer hardware has evolved to meet the needs of multi-processing systems.
2. Students will understand the major components of a computer including CPU, memory, I/O and storage.
3. Students will understand the uses for cache memory.
4. Students will understand a wide variety of memory technologies both internal and external.
5. Students will understand the role of the operating system in interfacing with the computer hardware.
6. Students will understand the basic components of the CPU including the ALU and control unit.
7. Students will have a basic understanding of assembly programming.
8. Students will understand design principles in instruction set design including RISC architectures.
9. Students will understand parallelism both in terms of a single processor and multiple processors.

Course Content

Textbook: *Computer Organization & Architecture: Designing for Performance*, Seventh Edition, by William Stallings. The following chapters are covered (See textbook "Contents").

1. **Computer Evolution and Performance**. History of computers, designing for performance, Pentium and PowerPC evolution.
2. **A Top-Level View of Computer Function and Interconnection**. Computer components, functions, interconnection structures, bus architecture, PCI.
3. **Cache Memory**. Computer memory system overview, cache memory principles, elements of cache design, Pentium and PowerPC Cache organization.
4. **Internal Memory**. Semiconductor main memory, error correction, DRAM.
5. **External Memory**. Magnetic disk, RAID, optical memory, magnetic tape.
6. **Input/Output**. External devices, I/O modules, programmed I/O, direct memory access, I/O channels and processors.
7. **Operating System Support**. Overview of operating system software, scheduling, memory management, Pentium and PowerPC management.
8. **Computer Arithmetic**. ALU, integer representation, integer arithmetic, floating-point representation, floating-point arithmetic.
9. **Instruction Sets: Characteristics and Functions**. Machine instruction characteristics, operand types, data types, assembly language.
10. **Instruction Sets: Addressing Modes and Formats**. Addressing, instruction formats.
11. **Processor Structure and Function**. Processor organization, registers, instruction cycle, instruction pipelining.
12. **Reduced Instruction Set Computers**. Instruction execution characteristics, registe files, compiler register optimization, RISC architecture.
13. **Instruction-Level Parallelism and Superscalar Processors**. Design issues.
14. **Control Unit Operations**. Micro-operations, control of the processor.
15. **Micro-programmed Control**. Sequencing, execution of instructions.
16. **Parallel Processing**. Multiple processors, cache coherence, multi-threading, clusters.