Microprocessor and Assembly Language (301 عال**)**

Course Description

In this course, we will cover topics such as Machine organization; assembly language: addressing, stacks, argument passing, arithmetic operations, decisions, modularization; Input/Output Operations and Interrupts; Memory Hierarchy and Cache memory; Pipeline Design Techniques; Super scalar architecture; Parallel Architectures.

Course Objective

By the completion of the course the students should be able to

1. Ability to analyze, write, and test MIPS assembly language programs.
2. Ability to describe the organization and operation of integer and floating-point arithmetic units.
3. Ability to apply knowledge of mathematics in CPU performance analysis and in speedup computation.
4. Ability to design the datapath and control unit of a processor.
5. Ability to use simulator tools in the analysis of assembly language programs and in CPU design.

References

Required:

David Patterson and John Hennessy. Computer Organization & Design:

The Hardware/Software Interface. Morgan Kaufmann Publishers, 2005(Third Edition)

Recommended:

Robert Britton. MIPS Assembly Language Programming. Pearson Prentice Hall, 2004

Prerequisite: Digital logic design (211 **عال**)

Evaluation Method:

Method	Percentage
Quizzes & Assignments	10%
Lab	10%
Projects	10%
Test 1 & Test 2	30%
Final Examination	40%

Weeks	Topic Name	*Sub Topic*	*Reading Chapter*
1	**Introduction**	Introduction to computer architecture, assembly and machine languages, components of a computer system, memory hierarchy, instruction execution cycle, chip manufacturing process, technology trends, programmer's view of a computer system.	1&2
2	**Review of Data Representation**	Binary and hexadecimal numbers, signed integers, binary and hexadecimal addition and subtraction, carry and overflow, characters and ASCII table.	2.

Weeks	Topic Name	*Sub Topic*	*Reading Chapter*
3	**Instruction Set Architecture**	Instruction set design, RISC design principles, MIPS instructions and formats, registers, arithmetic instructions, bit manipulation, load and store instructions, byte ordering, jump and conditional branch instructions, addressing modes, pseudo instructions.	2
4	**MIPS Assembly Language Programming**	Assembly language tools, program template, directives, text, data, and stack segments, defining data, arrays, and strings, array indexing and traversal, translating expressions, if else statements, loops, indirect jump and jump table, console input and output.	2
5	**Procedures and the Runtime Stack**	Runtime stack and its applications, defining a procedure, procedure calls and return address, nested procedure calls, passing arguments in registers and on the stack, stack frames, value and reference parameters, saving and restoring registers, local variables on the stack.	4
6	**Test 1**		

Weeks	Topic Name	*Sub Topic*	*Reading Chapter*
7	**Interrupts**	Software exceptions, syscall instruction, hardware interrupts, interrupt processing and handler, MIPS coprocessor 0.	4
8&9	**Integer Arithmetic and ALU design**	Hardware adders, barrel shifter, multifunction ALU design, integer multiplication, shift add multiplication hardware, Shift-subtract division algorithm and hardware, MIPS integer multiply and divide instructions, HI and LO registers.	4
10	**Floating-point arithmetic**	Floating-point representation, IEEE 754 standard, FP addition and multiplication, rounding, MIPS floating-point coprocessor and instructions.	3
11	**CPU Performance**	CPU performance and metrics, CPI and performance equation, MIPS, Amdahl's law.	4&7
12	**Test 2**		
13	**Single-Cycle Datapath and Control Design**	Designing a processor, register transfer, datapath components, register file design, clocking methodology, control signals,	4&7

Weeks	Topic Name	*Sub Topic*	*Reading Chapter*
		implementing the control unit, estimating longest delay.	
14	**Pipelined Datapath and Control**	Pipelining concepts, timing and performance, 5-stage MIPS pipeline, pipelined datapath and control, pipeline hazards, data hazards and forwarding, control hazards, branch prediction.	4&7
15	**Final Examination**		