CSE 3103: Microprocessor and Microcontroller

Professor Upama Kabir

Computer Science and Engineering, University of Dhaka,

Lecture 1

January 15, 2024

Course Description

Microprocessor is a required course for under-graduate students in the CSE program. The purpose of this course is to teach students the fundamentals of microprocessor and microcontroller systems. The student will be able to incorporate these concepts into diverse scenario where control can be achieved via a microprocessor/controller implementation. This course will provide an insight of ARM Cortex M4 Microprocessor organization, The C Programming Language, Assembly Language, I/O techniques, device interfaces, applications, hardware and software and STM32 Microcontroller.This course consists of two parts:

1. The first part studies of Cortex M4, a 32-bit microprocessor architectures, instruction sets and other related topics on microprocessor design scenarios, assembly programming .
2. The second part consists of STM32 microcontroller architecture, memory organizations, interfacing techniques, buses and protocols, selected programming techniques.

Course Objective/Outcome

At the end of this course, the successful student will be able to:

1. Architect a microprocessor or microcontroller system and estimate the required hardware and software resources.
2. Understand the detailed hardware design of a microprocessor or microcontroller system.
3. Program the microprocessor or microcontroller using suitable techniques .
4. Use technical knowledge on microprocessor architecture, I/O interface and peripherals, assembly/C language programming and debugging methodology.
5. Learn good practices in structuring a microprocessor control program. Apply the programming principles to define an accurate programming problem statement. Describe differences between the various approaches to solving a programming problem using assembly/C language.

Readings

1. Text Book: The definitive guide to the ARM Cortex-M3 and Cortex-M4 Processors: Joseph Yiu
2. References:
   - Video lecture on Cortex M4 on Youtube
   - Reference manual: STM32F446xx advanced Arm ® -based 32-bit MCUs
   - Data Sheet : STM32F446xC/E
   - Cortex-M4 Devices Generic User Guide
   - Cortex-M4 Technical Reference Manual

Topics to be covered

- Architecture
  - Features of ARM Architecture
  - Versions of ARM
  - Specific Features of ARM Cortex.
  - Three stage pipeline of Cortex.
  - Registers – General Purpose, Special Purpose in ARM Cortex M4
  - Memory Features.
  - Bit Band Region.
  - The Thumb-2 Technology
  - Difference between ARM and Thumb Instructions in Classical ARM Processors.
  - Interrupts/Exceptions
  - Floating Point Unit (FPU)
  - Memory Managemnet Unit (MMU)
  - Debug and Trace Features

Topics to be covered

- Instruction Set Architecture (ISA)
  - Moving data within the processor
  - Memory accesses
  - Arithmetic and logical operations
  - Shift and Rotate operations
  - Bit field processing instructions
  - Program flow control (branch, conditional branch, conditional execution, and function calls)
  - Multiply accumulate (MAC) instructions
  - Memory barrier instructions
  - Exception-related instructions
  - Stack and Stack pointer
  - Subroutine and function
- Programming
  - Getting started with Keil Microcontroller Development Kit for ARM
  - Assembly Language for ARM

Assessment Policy

- MidTerm Exam : 15 [Month of March]
- Quizz 1: 5 [12.02.2024]
- Quizz 2: 5 [29.03.2024]
- Quizz (Sudden): 5

Attendance in class is expected. Attendance will be collected during the class time for further usage. If you are unable to attend class, it is your responsibility to obtain class notes or other information. Make-up quizzes will not be allowed !!!

Course Teachers

- Professor Upama Kabir : upama@cse.du.ac.bd
- Professor Mosaddek Hossain Kamal Tushar