Indian Institute of Technology Tirupati

CS4100: Computer System Design

Credit: L-T-P-C : 3-0-0-3

1 About the Course

The course teaches a design methodology for a computer system which includes the hardware as well as software. The primary focus of this course is to learn the design methodology of large system. However, the course also covers some of the important computer system design principles. The course takes a bottom-up approach in teaching the complete syllabus. The bottom-up approach starts with learning digital design methodology which uses a hardware description language and finally proceed to design a computer system having memory and processor. Thereafter, the software systems starting from virtual machine to high-level programming language will be covered. The course also reviews the current design practice of different computer systems as part of the assignment exercise. The learning will be assessed and evaluated through term examinations and assignments. This course is accompanied by corresponding laboratory course where all the exercises of designing a computer system will be conducted.

2 Course Plan

The course will progress according to the following plan. The course will progress in synchronization with its laboratory exercises which will be executed as part of CS4110. Starting from the digital design metholdolgy to the processor design then to the software architecture will be covered.

- Lecture 1 (2 Aug): Introduction and organisational meeting
- Lecture 2 (7 Aug): Boolean Logic, Basic Gates and Hardware Descriptor Language
- Lecture 3 (9 Aug): Combinational Logic Design using HDL
- Lecture 4 (14 Aug): Arithmetic Circuit Design and Simulation
- Lecture 5 (16 Aug): Dequential Design Concepts: Flip-flops and Timing
- Lecture 6 (21 Aug): Register and Memory System Design
- Lecture 7 (23 Aug): Machine Langugage: Example from MIPS
- Lecture 8 (28 Aug): HACK Machine Language
- Lecture 9 (4 Sep): Review of Computer Architecture Concepts
- Lecture 10 (6 Sep): Specifying the Architecture Components: Single Cycle Processor Design
- Lecture 11 (11 Sep): Specifying the Architecture Components: Multicycle Processor Design
- Lecture 12 (13 Sep): Test 1 (this lecture to takes place in other slot)
- Lecture 13 (18 Sep): Assignemnt 1 Discussion
- Lecture 14 (20 Sep): Specifying the Architeture Components: Memory System Design
- Lecture 15 (25 Sep): Interface for input output system
- Lecture 16 (27 Sep): HACK Assembly Language Programming
- 2 Oct: Off for Gandhi Jayanti
- 4 Oct: Mid semester break

- Lecture 17 (9 Oct): HACK Assembly to Binary Translation
- Lecture 18 (11 Oct): Virtual Machine (VM) Stack Model
- Lecture 19 (16 Oct): Virtual Machine Specification
- 18 Oct: Test 2 (Lecture to take place in alternative slot)
- Lecture 20 (23 Oct): Implementation of VM on HACK platform
- 25 Oct: Test 2 (Lectur to take place in alternative slot)
- Lecture 21 (30 Oct): Assignment 2 Discussion
- Lecture 22 (1 Nov): Implementation of VM on HACK platform
- Lecture 23 (6 Nov): VM Program Control: the Concept Review
- Lecture 24 (8 Nov): Specification and Implementation of Program Control
- Lecture 25 (13 Nov): High-level Programming Language: Review of Concept
- Lecture 26 (15 Nov): A Programming Language for HACK
- Lecture 27 (20 Nov): Programming for HACK
- Lecture 28 (22 Nov): Free back-up slot
- Assignment 1: RISC-V and OpenMIPS Based System Design (Rocket Chip and Shakti Processor)
- Assignment 2: Heterogeneous System-on-Chip Design: Study of Power, Performance and Timing
- Midterm 1: The test will be based on the syllabus covered till the date of Midterm 1. The format of test paper will be informed prior to the test.
- Midterm 2: Midterm test will cover the syllabus excluding the Midterm 1.
- Endterm: The Endterm will cover the entire syllabus however weightage will be given more to the new portion of the syllabus.

3 Evaluation

Mid-term Test:	30%
Assignment	30%
Final Test:	40%

4 Rules

The code of conduct as per the institute should be followed with due respect. The deadline should be respected for assignments. Plagiarism or any such activity are strictly discouraged.

5 References

- Noam Nisan and Shimon Schocken, The Elements of Computing Systems: Building a Modern Computer from First Principle, The MIT Press, Cambridge, 2008. Link to course material: nand2teris.org.
- David Patterson and John L. Henessy, Computer Organisation and Design: The Hardware Software Interface, Morgan Kaufmann An Imprint of Elsevier, 2014.
- Ronald Bryant and David R O'Hallaron, Computer Systems: A Programmer Perspective, Pearson India Education, 2016.
- Michael J Flynn and Wayne Luk, Computer System Design: System-on-Chip, John Wiley and Sons Inc, 2011

6 Contacts and Resources

Instructor: Jaynarayan T Tudu [jtt@iittp.ac.in]
Teaching Asst: To be informed

The course news, teaching materials etc will be updated in the course page hosted in google classroom.