INTRODUCTION TO COMPUTER ARCHITECTURE

Debiprasanna Sahoo
Assistant Professor
Department of Computer Science and Engineering
School of Electrical and Computer Sciences
Indian Institute of Technology Bhubaneswar

Philosophy behind being an architect

WHO SHOULD BE INTERESTED TO PURSUE A CAREER

- Passionate about digital logic
- Imaginative designer
- Crazy about how even such a system exists and is working
- Smart coder and patience to read code ☺

History is great!

Who is current Semiconductor Market Leader?

Who is the manufacturer of SRAM?

Year of Start	Company	Year of Release First Processor
1899	Nippon Electrical Company (NEC)	1984
1911	International Business Machines (IBM)	1960s
1927	Galvin Manufacturing Corporation (Motorola in 1947)	1974
1951	Texas Instruments (TI)	1971
1968	Integrated Electronics (Intel)	1971
1969	Advanced Micro Devices (AMD)	1971

Year of Start	Company	Year of Release First Processor
1993	Nvidia	GeForce 256 in 1999
1985	Array Technology Inc (ATI) now AMD Radeon	1987
1990	Advanced RISC Machines	Qualcomm, Apple, NXP, TI, Hitachi, Samsung, Marvell, Mediatek, Nvidia, and many more use ARM IP to build own chips.

Memory Manufacturers: Samsung, Hynix. Micron, Adata, Crucial, Kingston, Transcend, and many more

Jobs (Mainly CSE Students Aspect)

Performance Jobs: Working on simulators and projecting system performance using benchmarks. They also include running workload on real hardware and evaluating performance.

Verification Jobs: Functional and performance verification roles.

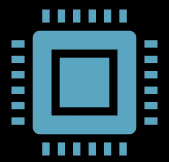
Design and RTL Jobs: Working on Verilog/VHDL/System Verilog to build real hardware logic.

Testing Jobs: Chip testing for defects

Top Research Publication Venues

ISCA, MICRO, ASPLOS, HPCA, ICCD, MemSys, PACT, ESWEEK, ISLPED, SC, ICS, etc.

DAC, DATE, ICCAD, ASP-DAC, VLSID, etc

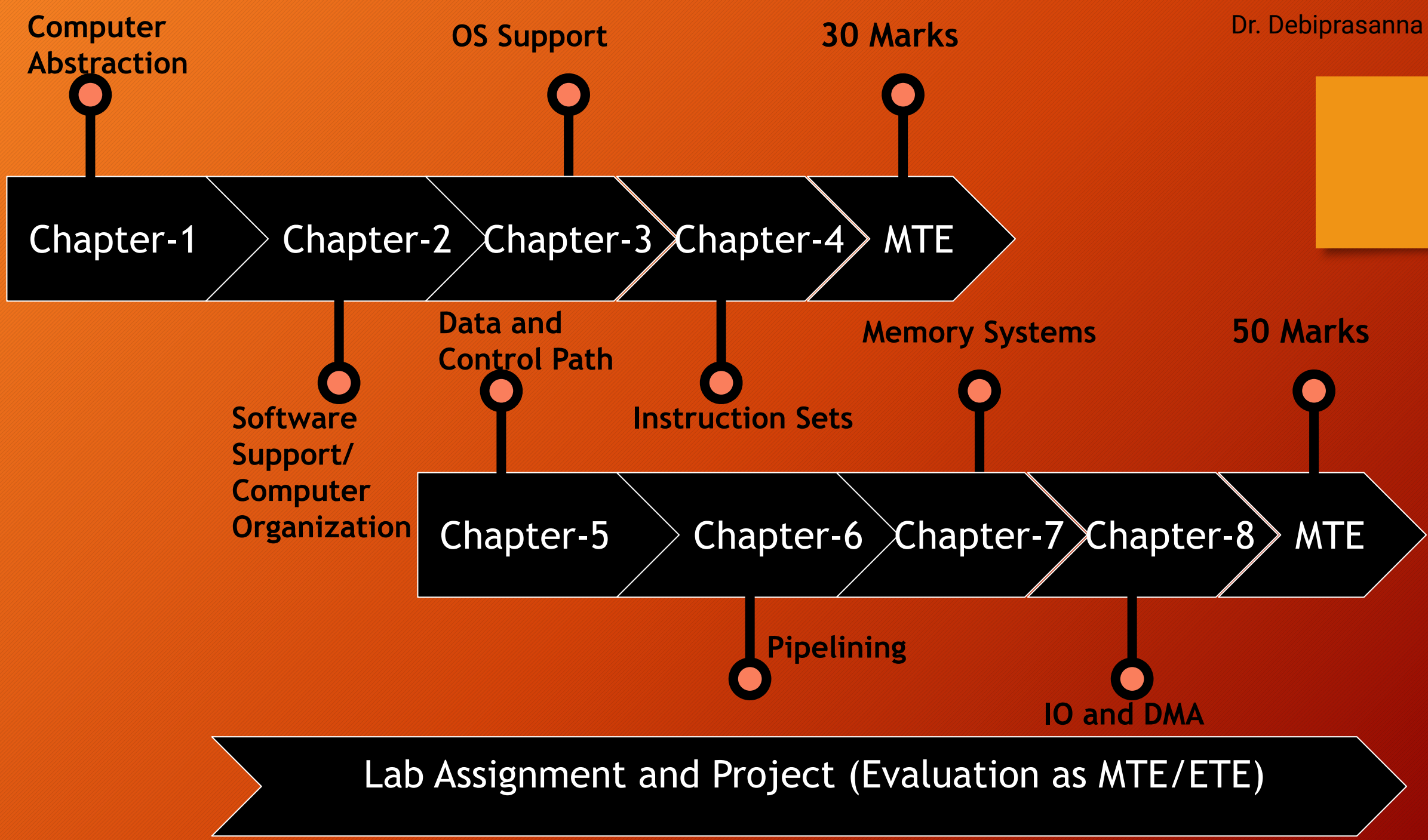


TACO, TCAD, TC, Journal of Microprocessors, CAL, TODAES, TECS, ESL, etc.

Evaluation

- Mid-Semester: 30% (Examination will be for 50 marks)
- End-Semester: 50% (Examination will be for 100 marks)
- Surprise Tests (one or two): 10%
- Attendance: 10%

Dr. Debiprasanna Sahoo



CONNECTIONS, PROFILES and DISCUSSIONS

- Bitbucket Account (Free for Academic Email IDs)
- Confluence Account (Free for Academic Email IDs)
- Office Hours: We have a long lab time!

Relationship of CA with Other Domains

Programming and Data Structures
Smart Programmers understand systems well
Designing New Language
Smart Architects are Expert Programmers
Ability to View Components as Objects
Parallel Programming
Debugging Skills

Digital Logic/Electronics
Fundamentals to Designing Systems
Understanding of Gates, Combinational Circuits, and Sequential Circuits
Physics of the devices will help building expertise

Algorithm Design
CA is the study of Hardware Algorithms!
Time Complexity (Performance Wall)
Space Complexity (Area Wall)
Design Complexity
Power Complexity (Power Wall)
Security Complexity, etc.

Mathematics
Elementary Mathematics
Theory of Computation: Mealy and Moore Machines are basis of designing complex systems
Queuing Theory: For experts

Relationship of CA with Other Domains

Operating Systems
System Software that manages the Hardware
Designing and Understanding OS requires understanding of Architecture
Application optimization at Hardware Software Boundary

Computer Networks
Fundamentals of Input Output Concepts
Fundamental of Devices in a Network
Processing Delay

Compiler Design
Back-end of the Compiler deals with code generation and Code Optimization (Hardware Target Specific)

Software Engineering
Computer Engineering part of Hardware Engineering is done by writing code!
Design and Verification is a challenge

Relationship of CA with Other Domains

Computer Graphics
Graphics Processing Unit

Data Science
Computer Hardware can produce more data than any other systems

Artificial Intelligence
We use predictors everywhere. E.g., Branch Prediction or Prefetehers
We have to support AI growth

Cloud/Edge Computing
CA + OS + CN + Application

Hardware Security
Cryptography,
Secured System Management

“Fuel the fire of innovation, and commence on a journey to shape the future of computing with passionate study of next-generation computer architecture!”

Ready!