

Welcome to CS220A: Computer Organization

Mainak Chaudhuri
Indian Institute of Technology Kanpur

Sketch

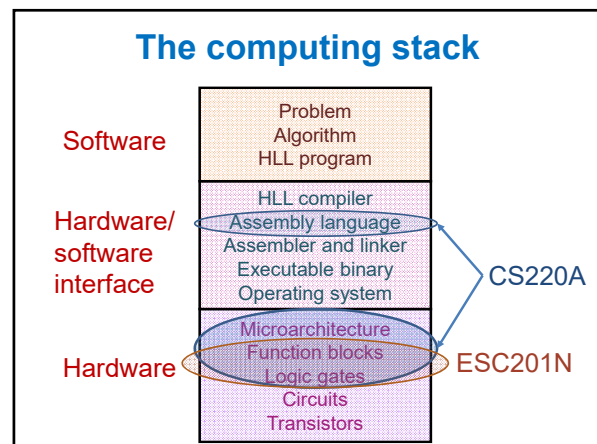
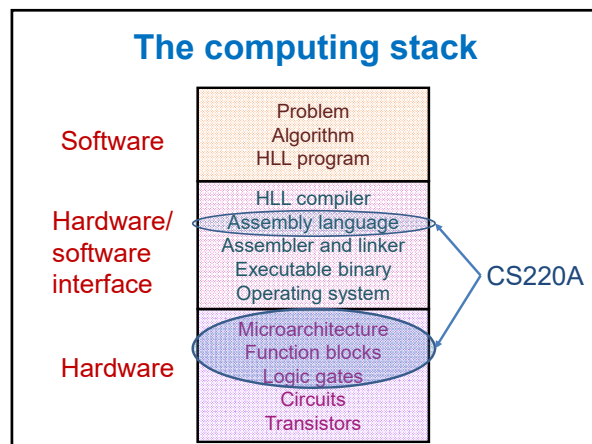
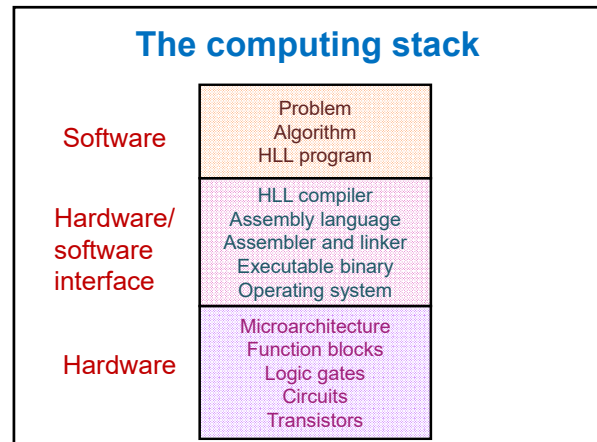
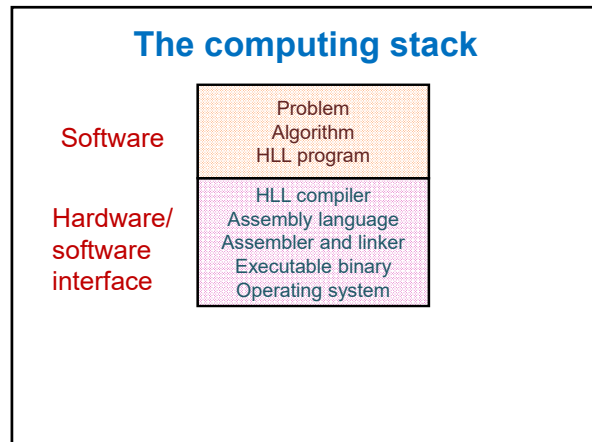
- The computing stack
- Anatomy of a computer system

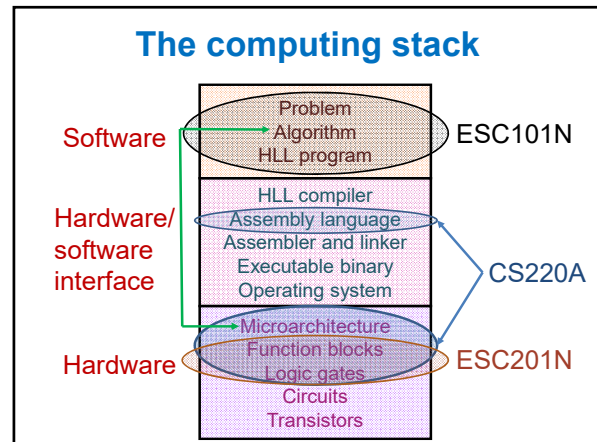
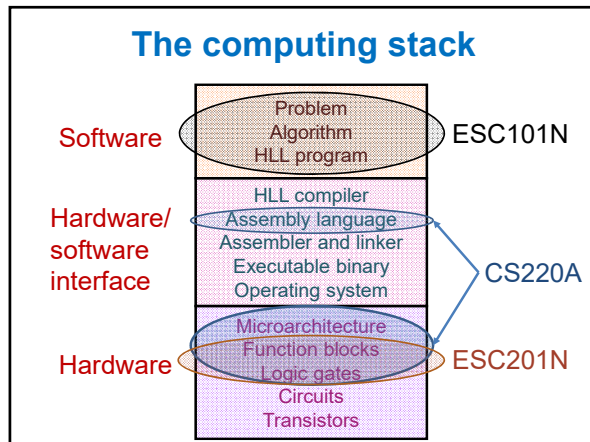
The computing stack

The computing stack

Software

Problem
Algorithm
HLL program

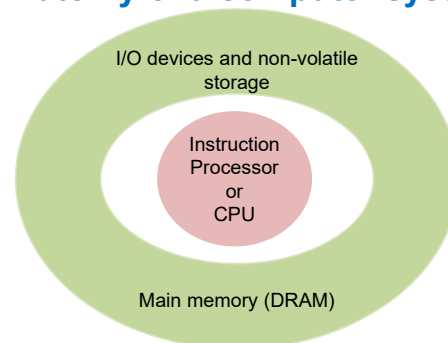




Logic gates to microarchitecture

- Example of a ripple-carry adder
 - Logic gates for building a function block for adding two bits with a carry input
 - Known as a full adder
 - An array of full adders used to design the microarchitecture of an adder
 - Encapsulates an algorithm for adding two n-bit numbers
 - A microarchitecture is always linked to an underlying algorithm for executing the task
- A digital computer represents one of the most complex pieces of microarchitecture
 - A complex algorithm implemented in hardware

Anatomy of a computer system



Anatomy of a computer system

- The central processing unit (CPU)
 - Also known as microprocessor
 - Dictates how a task will be done, but cannot do anything on its own
 - Needs to be told what to do next in the form of a stream of “instructions”
 - These instructions are generated from a program that represents an algorithm for accomplishing the task
 - Can store intermediate/final results of a computation in main memory
 - Dynamic random access memory (DRAM); volatile
 - Can store information on persistent non-volatile storage media e.g., magnetic hard disk

Anatomy of a computer system

- Peripheral I/O devices
 - Plug-ins to the CPU for communicating with the world
 - Display (CRT, LCD, touchscreen)
 - Keyboard
 - Mouse
 - DVD reader/writer
 - Speaker
 - Microphone
 - Camera
 - Wireless communication
 - Wired Ethernet communication

Anatomy of a computer system

- How does an instruction execute inside the processor?
 - Every entity residing inside a computer has an address
 - An instruction also has an address
 - The processor maintains the address of the next instruction in a register called program counter
 - The instruction is fetched from main memory and placed in an instruction register
 - The instruction is decoded to generate the control signals for executing the instruction
 - Send to adder if this is an addition instruction

Anatomy of a computer system

- How does an instruction execute inside the processor?
 - Most instructions require source operands for execution
 - $a+b$
 - After decoding the instruction, the operands are fetched
 - Operand addresses are typically encoded in the instruction or could be implicit
 - These addresses are known after decoding the instruction
 - The instruction can now execute
 - Operands are sent to the adder

Anatomy of a computer system

- How does an instruction execute inside the processor?
 - Most instructions generate a result
 - $c=a+b$
 - The address of the result (or destination) operand is typically encoded in the instruction or implicit
 - This address is known after decoding the instruction
 - The result is stored in the destination operand location

Anatomy of a computer system

- How does an instruction execute inside the processor?
 - The execution of an instruction requires the appropriate control and data paths to be activated
- Data path is usually slow because main memory is much slower than the processor
 - Commonly used optimizations for speeding up the data path:
 - Reasonably large set of general-purpose registers inside the processor
 - Fast memory (known as cache) inside the processor