Instruction Set Architecture

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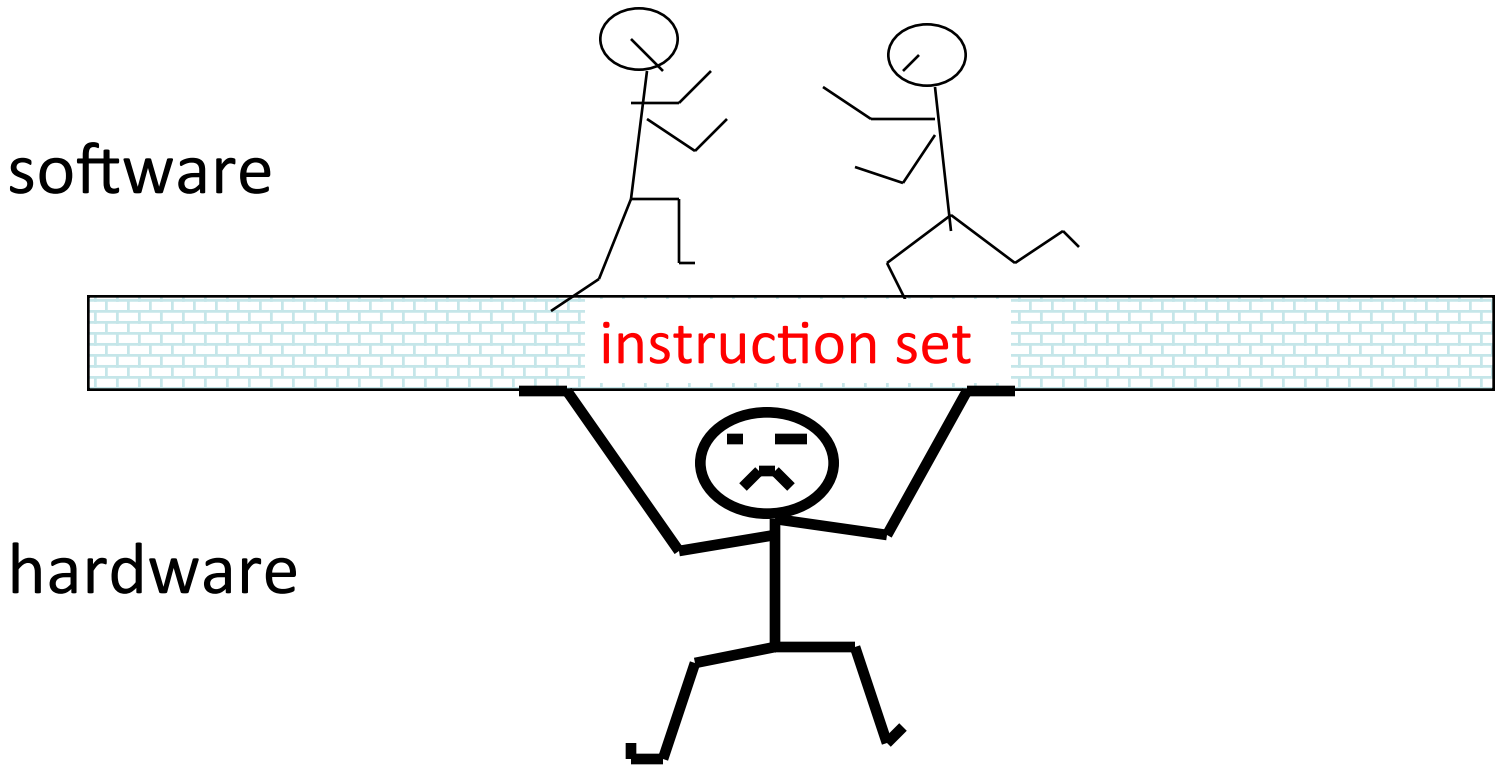
CADSL

Instruction Set Architecture

- Instruction set architecture is the structure of a computer that a machine language programmer must understand to write a correct (timing independent) program for that machine.

- The instruction set architecture is also the machine description that a hardware designer must understand to design a correct implementation of the computer.

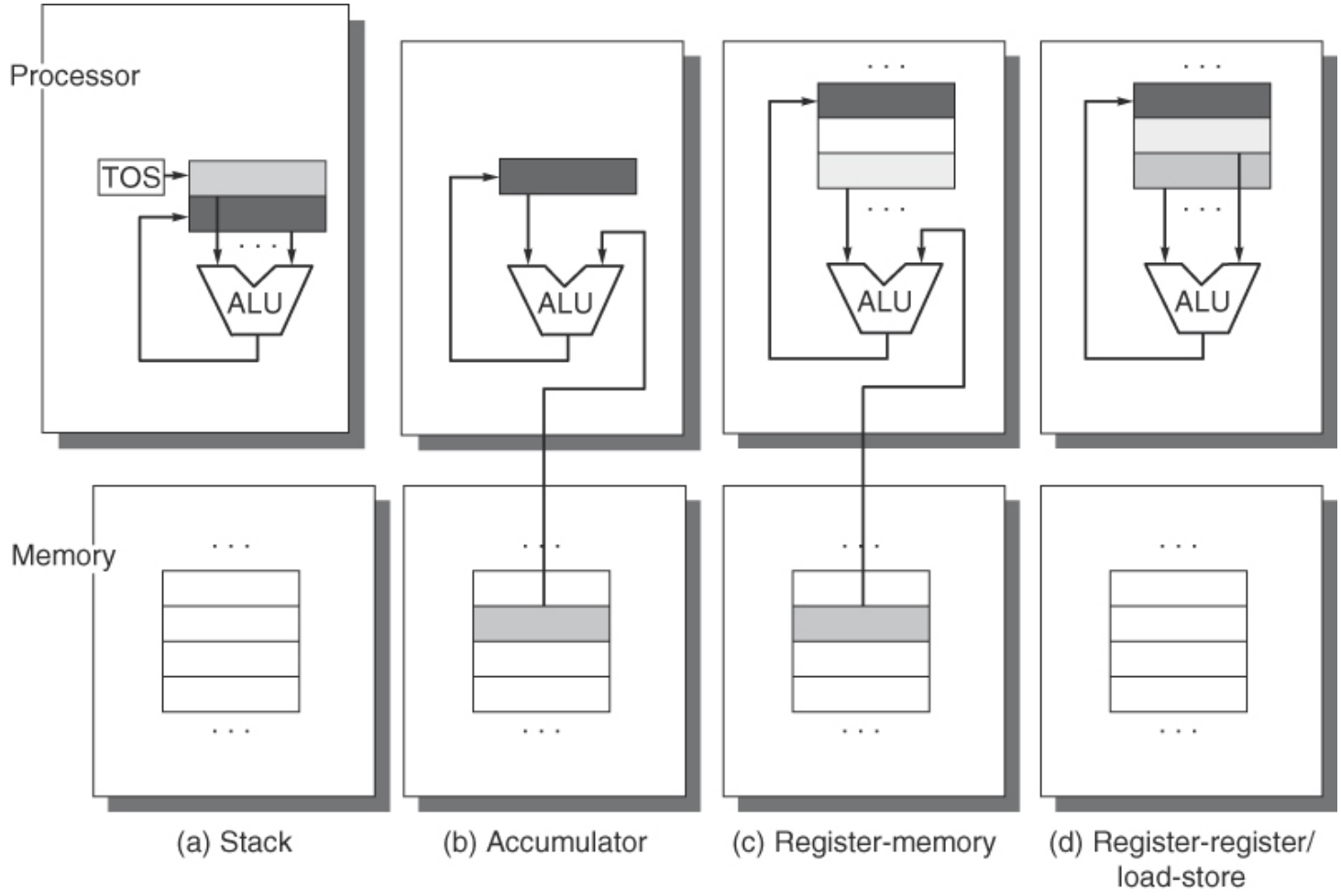
Instruction Set Architecture (ISA)



What Are the Components of an ISA?

- Sometimes known as *The Programmer's Model* of the machine
- Storage cells
  - General and special purpose registers in the CPU
- The machine instruction set
  - The instruction set is the entire repertoire of machine operations
- The instruction format
  - Size and meaning of fields within the instruction

Basic Machine Organizations



Source: CA: A quantitative approach

Complex vs. Simple Instructions

- Complex instruction: An instruction does a lot of work, e.g. many operations
  - Insert in a doubly linked list
  - Compute FFT
  - String copy

- Simple instruction: An instruction does small amount of work, it is a primitive using which complex operations can be built
  - Add
  - XOR
  - Multiply

Complex vs. Simple Instructions

- Advantages of Complex instructions
  - + Denser encoding → smaller code size → better memory utilization, saves off-chip bandwidth (better packing of instructions)
  - + Simpler compiler: no need to optimize small instructions as much

- Disadvantages of Complex Instructions
  - - Larger chunks of work → compiler has less opportunity to optimize (limited in fine-grained optimizations it can do)
  - - More complex hardware → translation from a high level to control signals and optimization needs to be done by hardware

Thank You