

Text Chapters Covered

1: Structure of computers

2 and **4:** Software: Assembly language

2: Hardware and Software:

Instruction Set Architecture (ISA)

3: Input and Output (I/O)

8: The memory system

5: Processing unit (CPU)

6: Pipelining

9: Arithmetic (covered throughout the course also in ECE241)

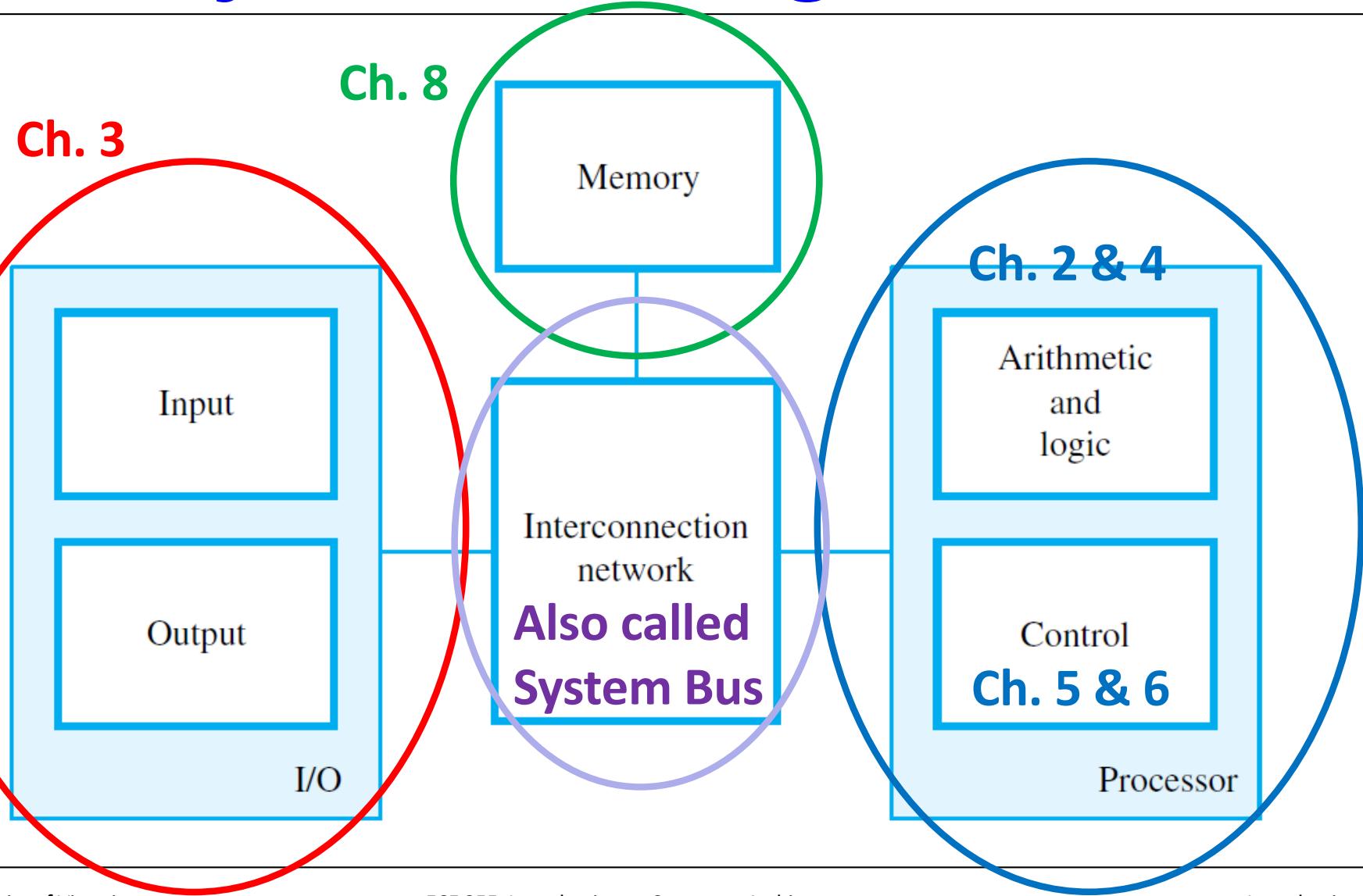
What is Computer Architecture?

- The art of assembling digital logic elements into a computing device
- The specification of the relation between parts of a computer system
- The organization and interaction of a computer's hardware and system software

An Engineer's Perspective

- A cost-effective design and implementation
of components in a computer system,
satisfying the required functional
specifications

System Building Blocks

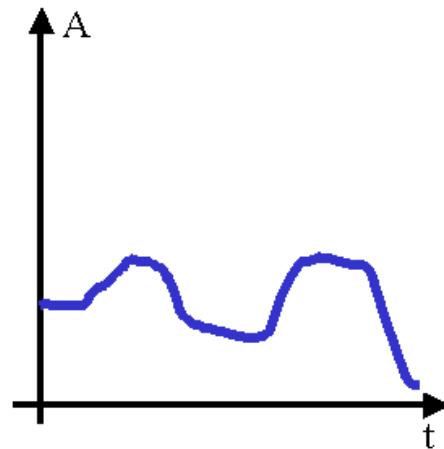


Input/Output

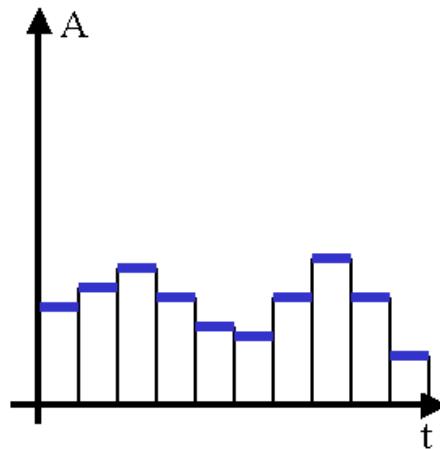
- Computer processes information in digital format
- External analog information must be converted to internal digital format before processing
- Internal digital information must be converted to analog format for external output control

Which format is artificial?

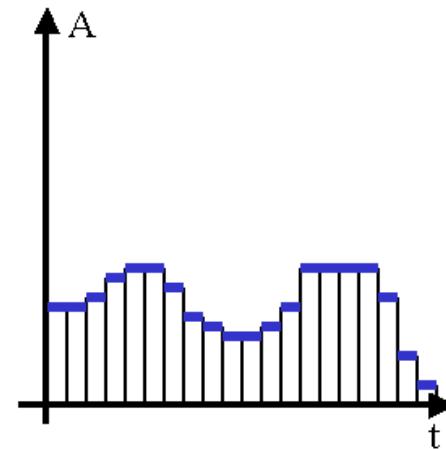
Analog vs Digital



Analog signal –
continuously varying



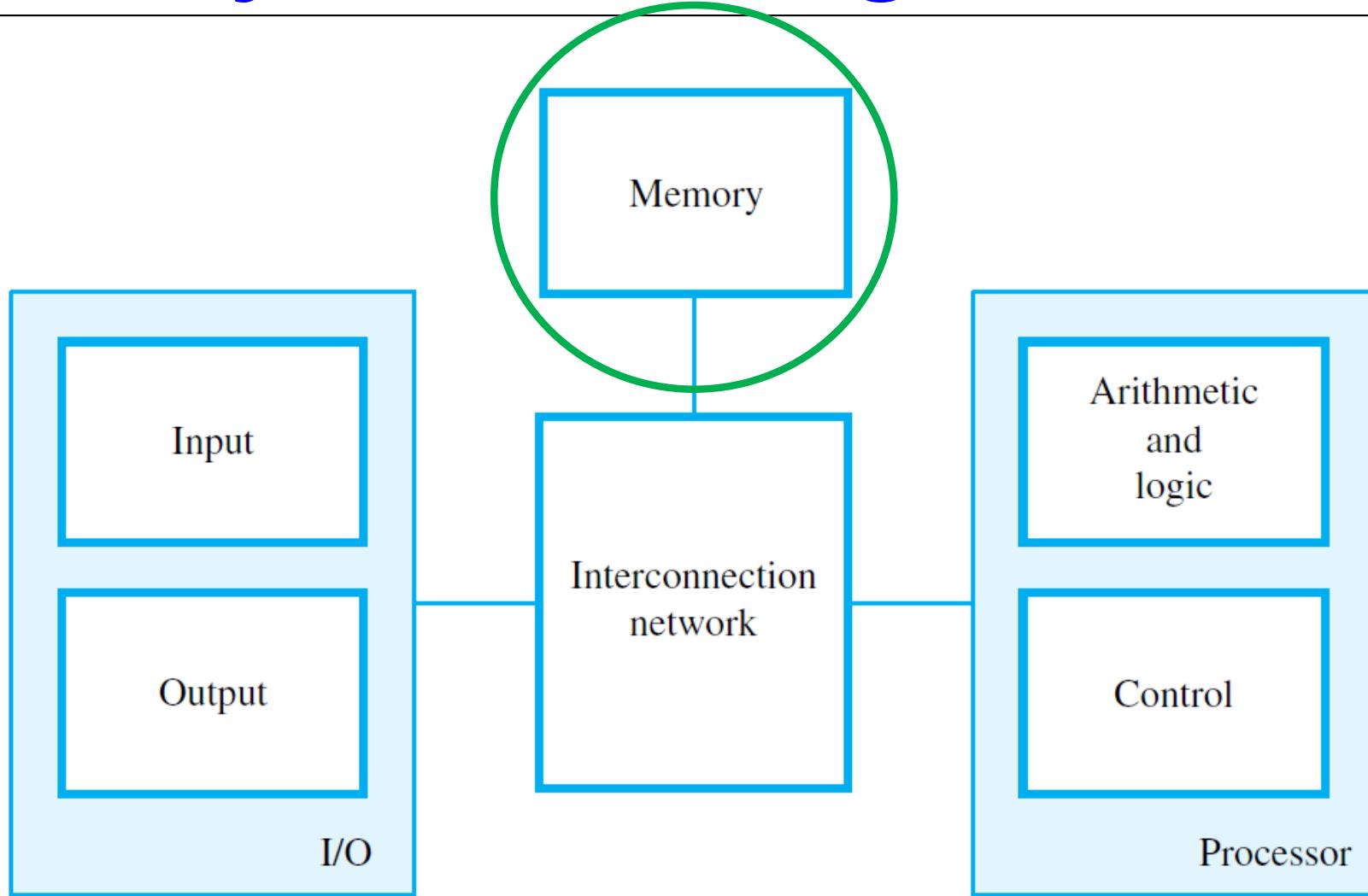
Digital signal – large
time divisions



Digital signal – small
time divisions

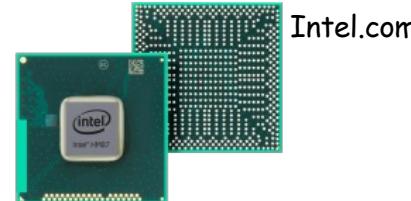
Checking room temperature:
1. Every 1 second?
2. Every 2 seconds?

System Building Blocks



Memory

- Cache Memory
- Primary (Main) Memory
 - Random Access Memory (**RAM**)
 - Read Only Memory (**ROM**)
- Secondary Memory
 - Hard drive, DVD, flash
 - For **Programs** and **Data storage**



Intel.com



Jotuts.
com

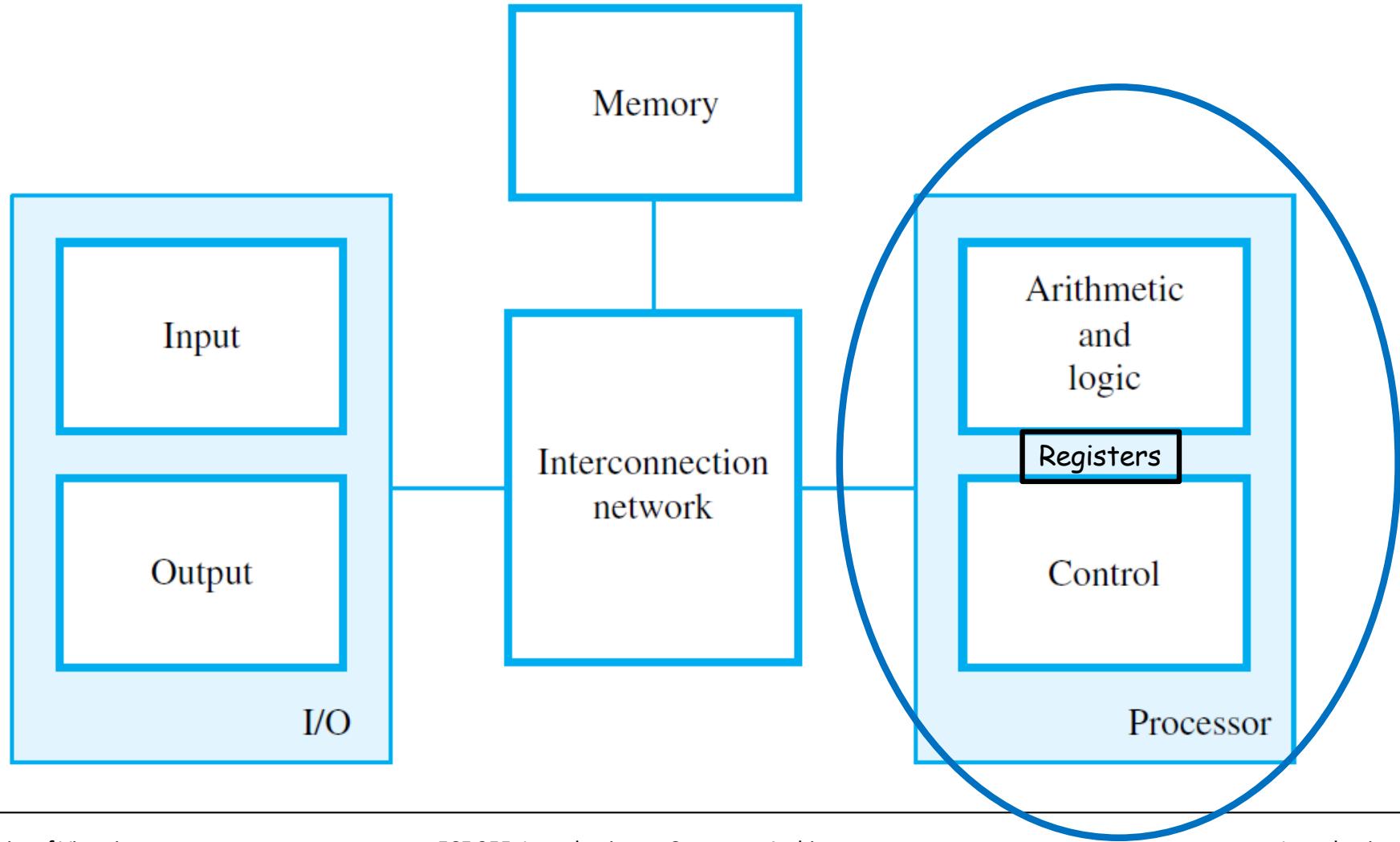


Seagate.com



Wikipedia

System Building Blocks



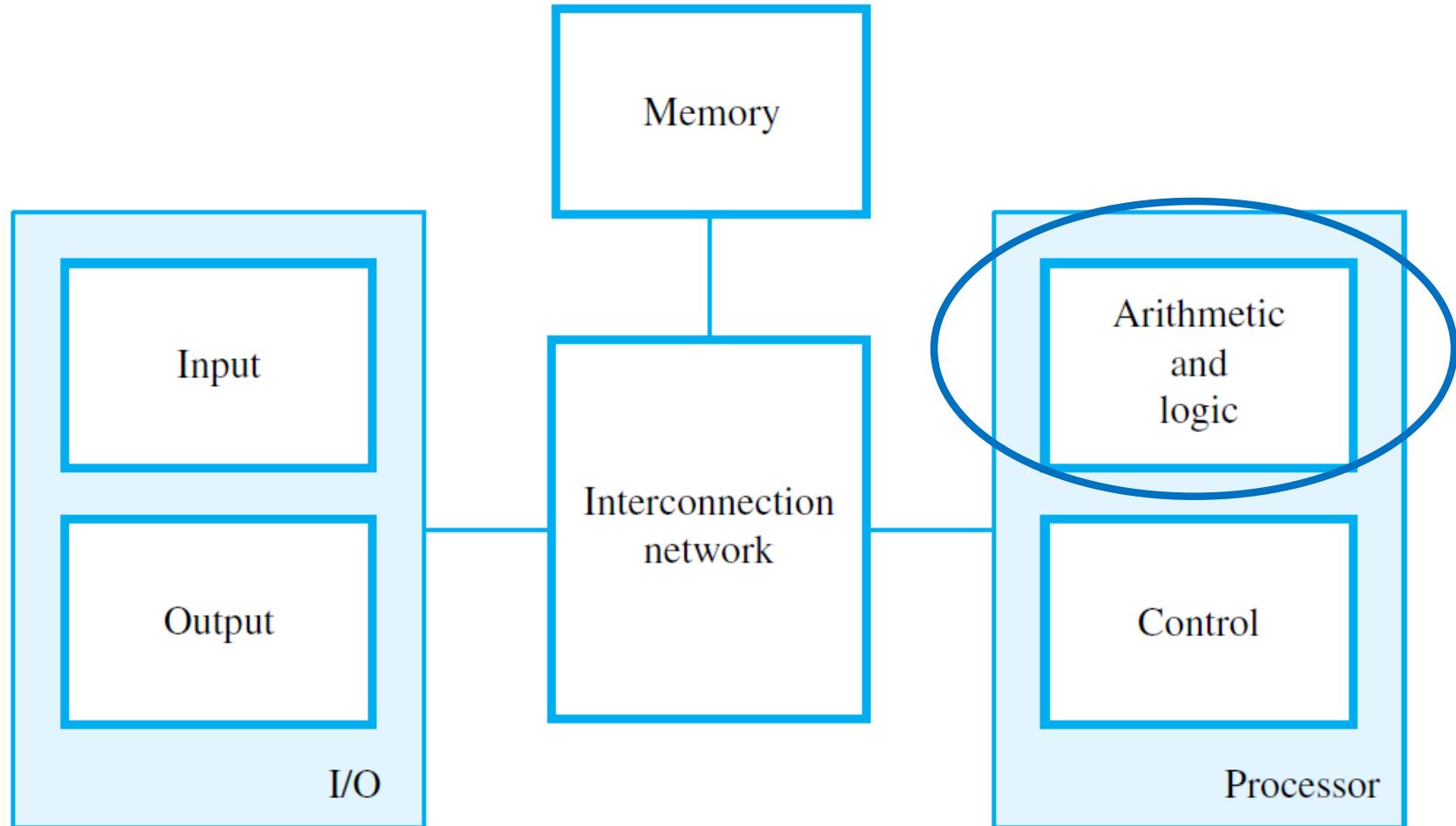
Processor

- Arithmetic and Logic Unit (ALU)
 - Electronic circuits for arithmetic & logic operations
- Control Unit
 - Circuits for controlling other components
 - Fetch and execute instructions (called instruction cycle)
- Registers
 - Temporary storage for data

Why temporary?

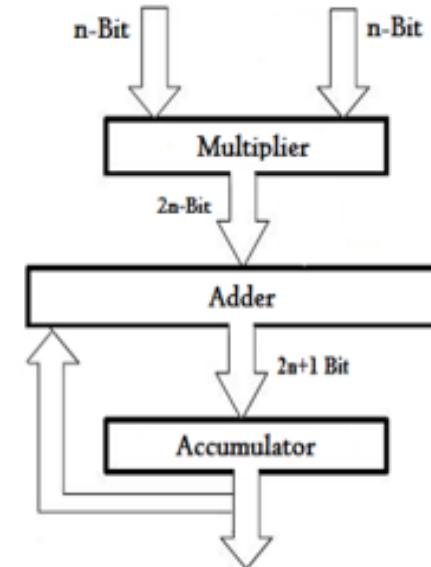
Data needed for
processor
calculation

System Building Blocks

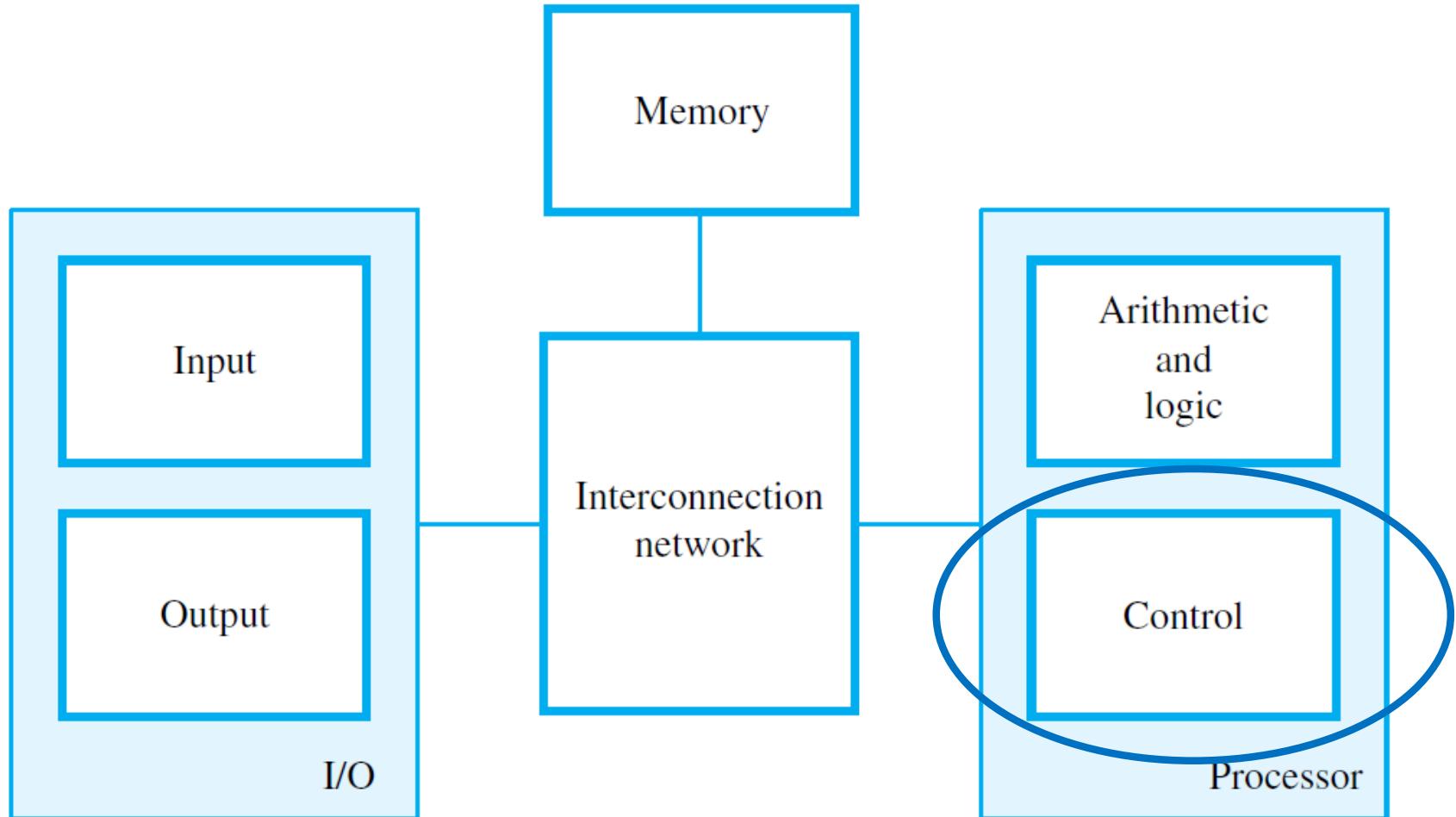


Arithmetic Logic Unit ALU

- Arithmetic operators:
 - +, -, *, /
- Logic operators:
 - AND (\wedge), OR (\vee), INVERT (\sim)
- Special purpose – Multiply and Accumulate (MAC)
- Integer and/or Floating-point operations



System Building Blocks



Control Unit

- Sends control signals to other units at regular time intervals
- 2 important aspects:
 - Sequencing – events occurrence in order
 - e.g., event #4, #9, #3 (out of 36 possible events)
 - Timing – when to do what
 - e.g., every 2ns for one event

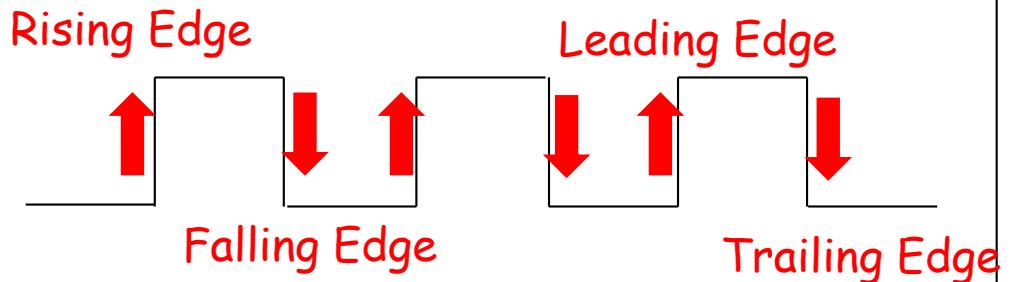
Events of $x:=y+1$?

1. Get y
2. Add 1 to y
3. Move to x

Control Unit

- System Clock to synchronize events

- e.g., 500 MHz



- Clock speed

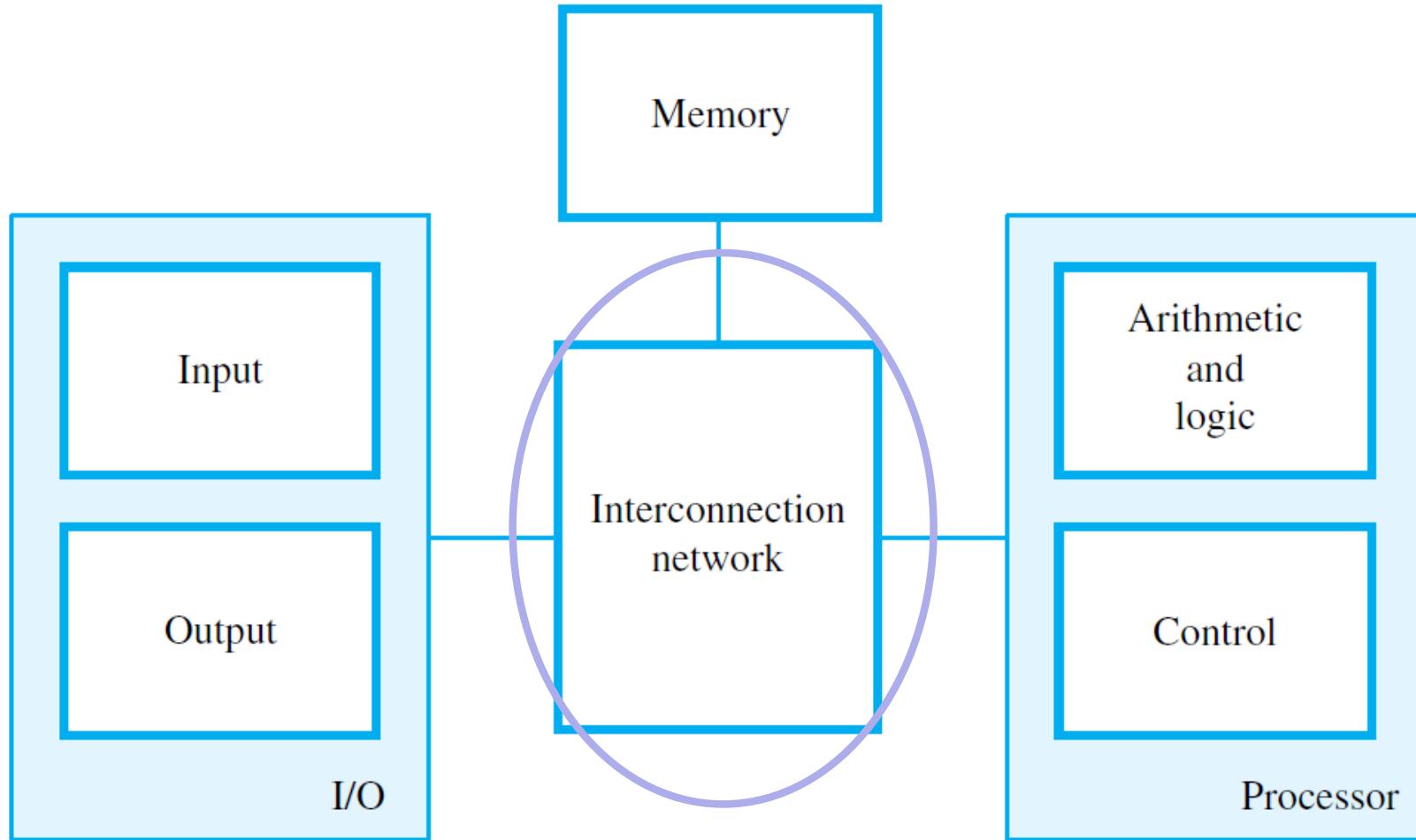
- Period (unit: **sec**)
 - Frequency (unit: **Hz**)
 - $500 \text{ MHz} = ? \text{ nsec}$

What is One Clock Cycle?

What is the width of the
of a clock cycle?

What is the height of the
of a clock cycle?

System Building Blocks



Interconnection Network (System Bus)

- 3 groups of signals/bits
1. Data Bus: 8/16/32/64/128 bits
 - An X-bit processor can manipulate X-bit data
 2. Address Bus: 8/16/32/64 bits
 - Location in memory; usually the same as data
 3. Control Bus: Read, Write, Start, Stop...(number of bits **depends on the processor**)