Microprocessor & Computer Architecture (µpCA)

UE19CS252

Dr. D. C. Kiran

Department of
Computer Science and Engineering

Microprocessor & Computer Architecture (µpCA)

Unit 3: Memory

Dr. D. C. Kiran
Department of Computer Science and Engineering

Microprocessor & Computer Architecture (µpCA)

Syllabus

~~Unit 1: Basic Processor Architecture and Design~~

~~Unit 2: Pipelined Processor and Design~~

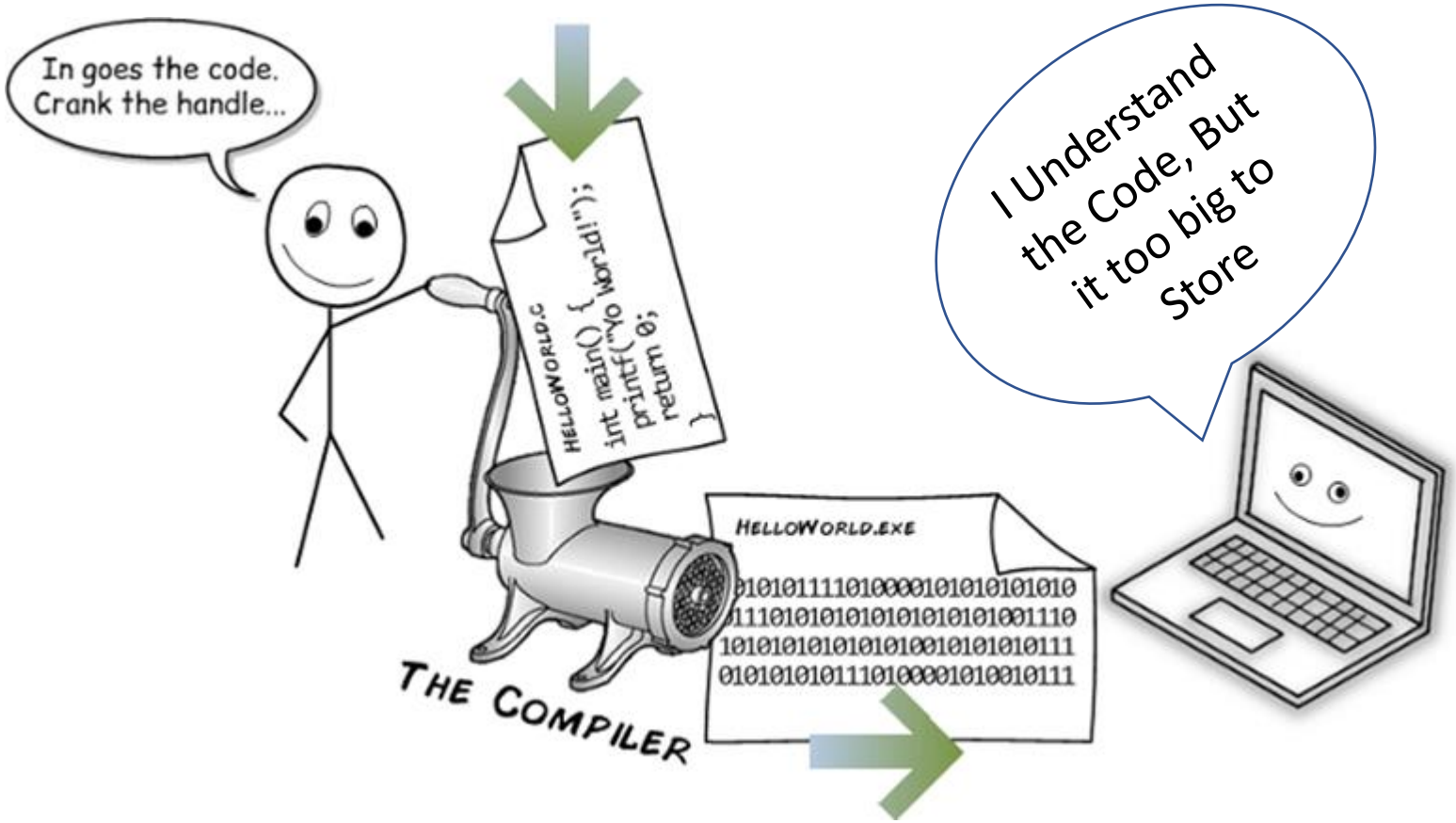
Unit 3: Memory

Unit 4: Input/Output Device Design

Unit 5: Advanced Architecture

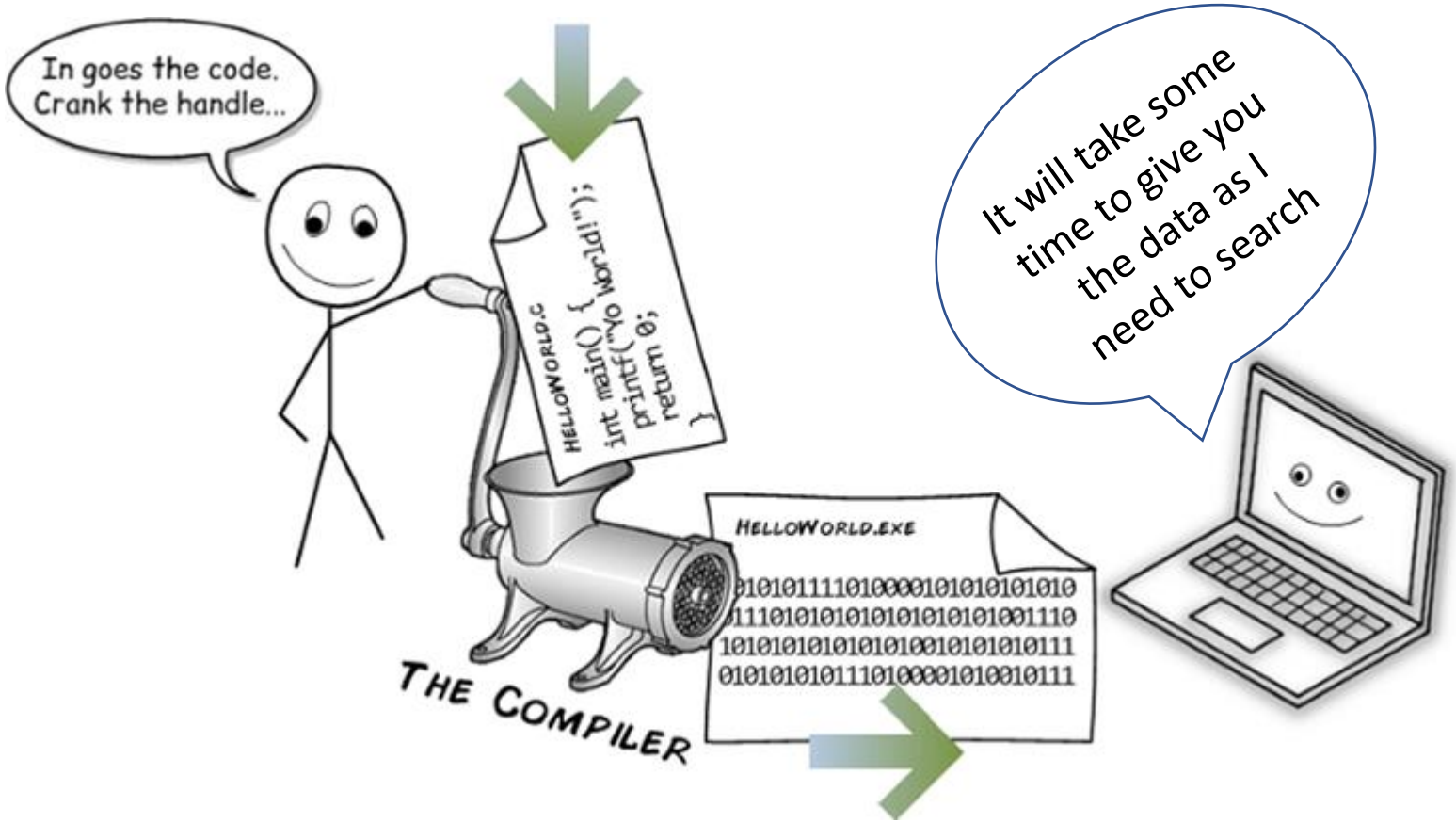
Microprocessor & Computer Architecture (µpCA)

Memory



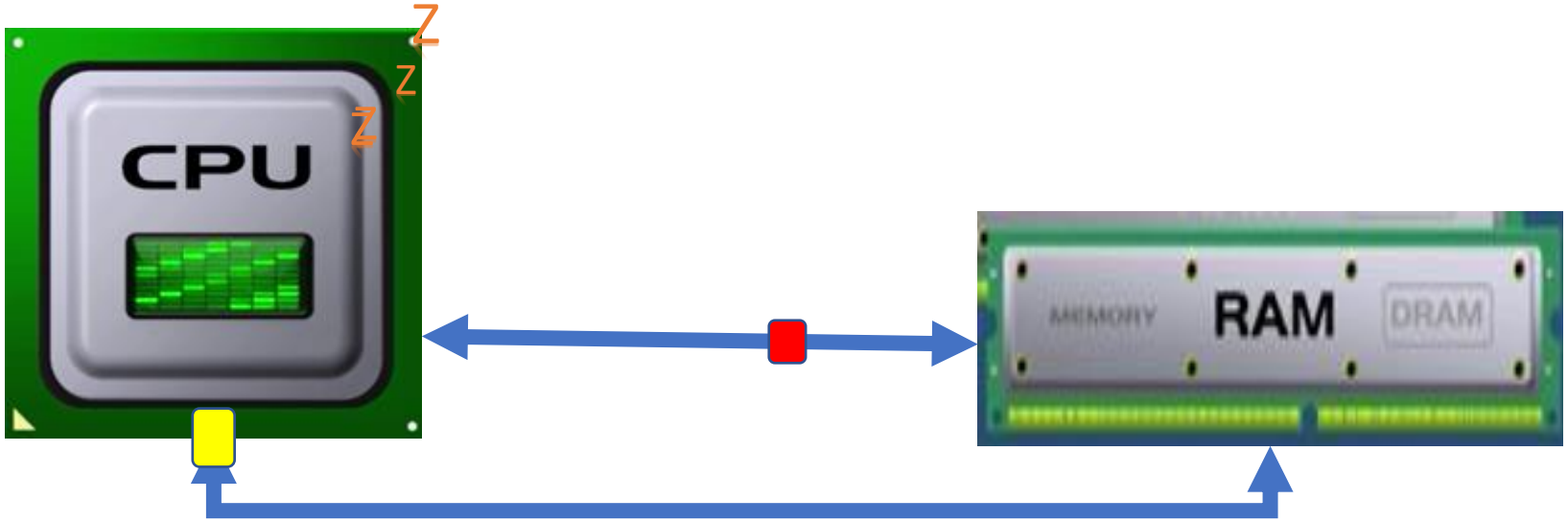
Microprocessor & Computer Architecture (µpCA)

Memory



Microprocessor & Computer Architecture (µpCA)

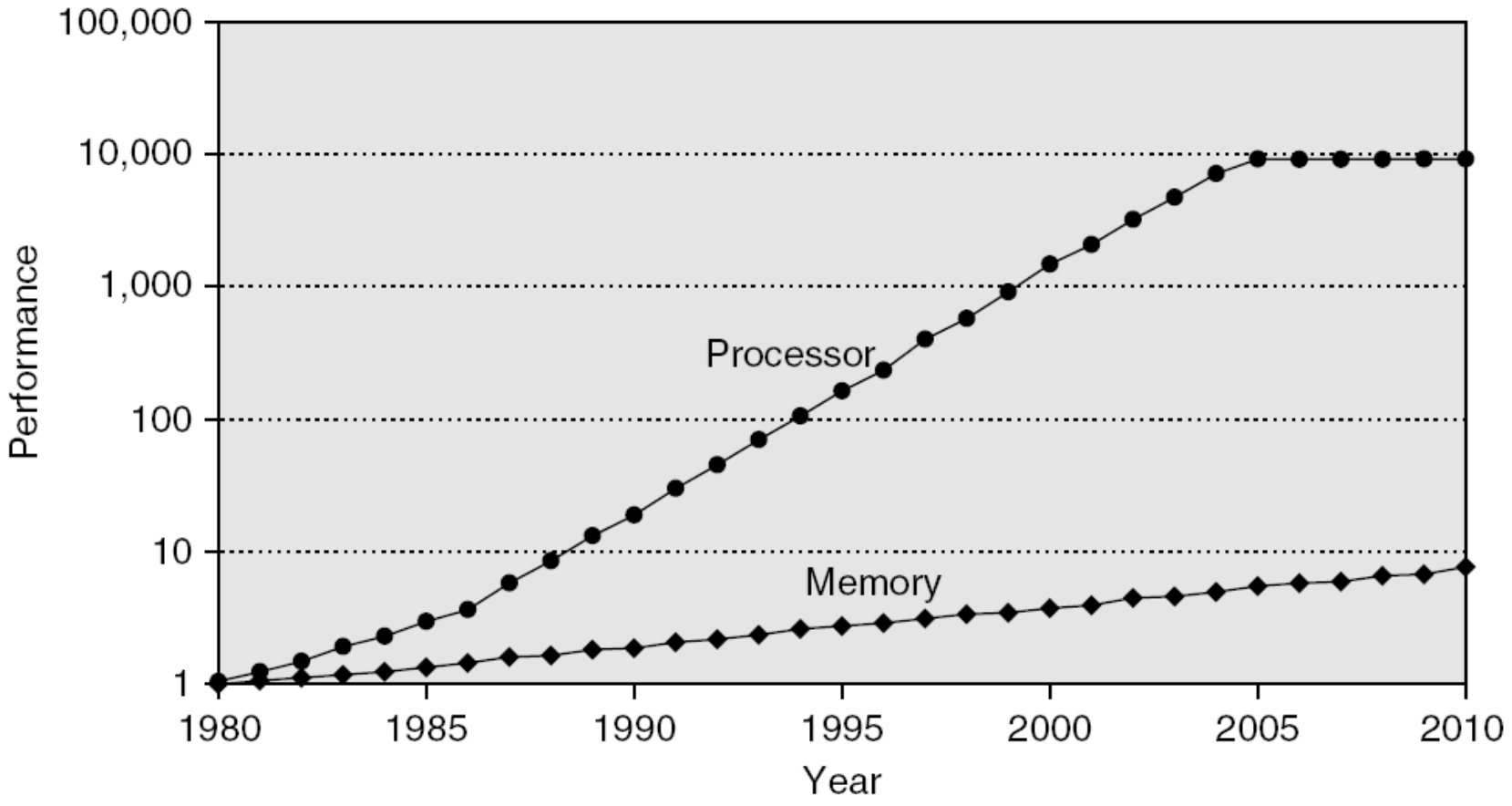
Processor Vs Memory



Processor Vs Memory

- Program is stored in Memory.
- Data required by Program stored in Memory.
- Executing Program on Processor is relatively faster than Accessing, Instruction and Data from Memory.
- CPU performance improves by 55% per year
- Memory performance improves by 7% per year
- Gap between CPU performance and memory performance increases year on year
- Fast memory technology is more expensive per bit than slower memory

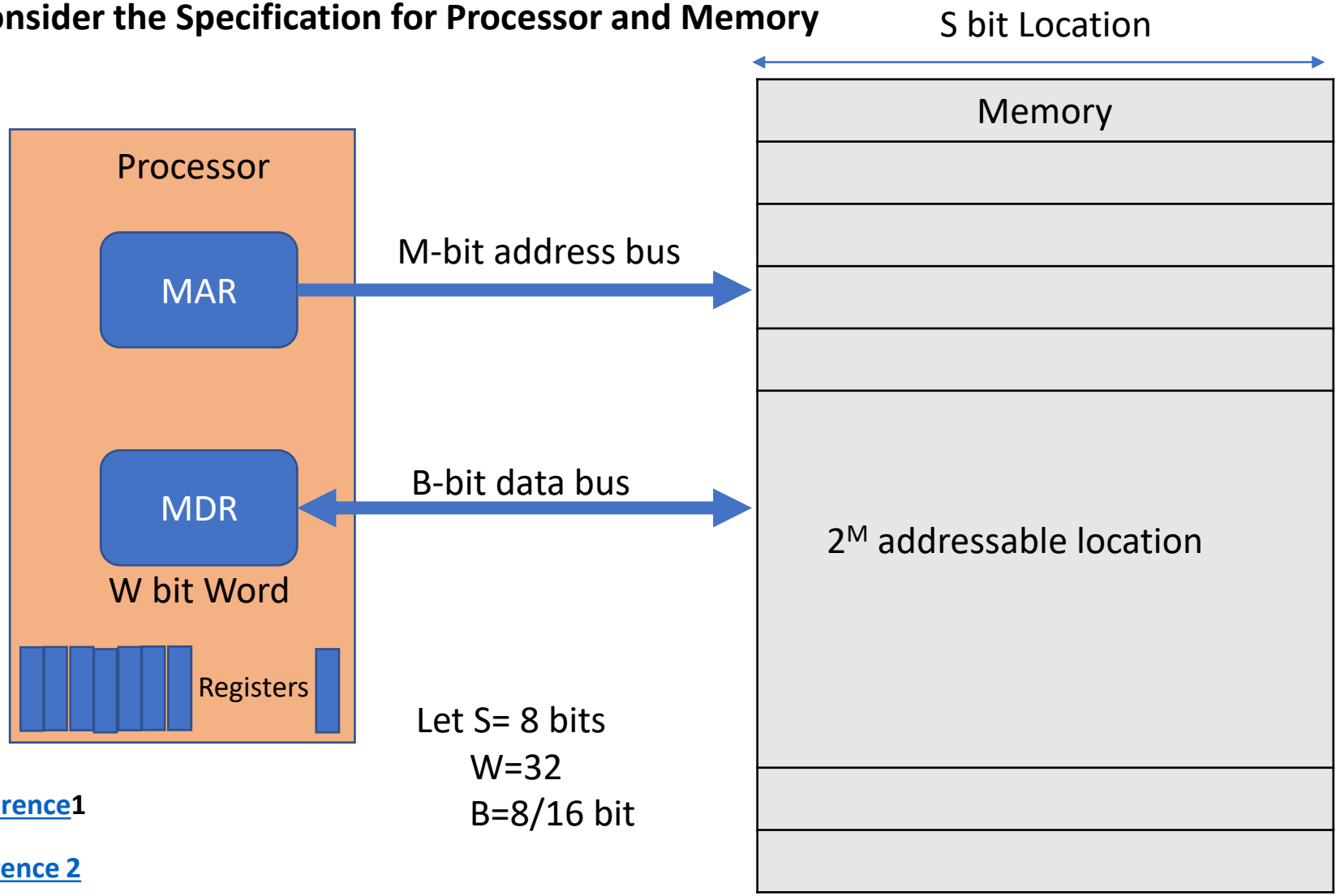
Memory Performance Gap



Microprocessor & Computer Architecture (µpCA)

One Reason!!!!!

Consider the Specification for Processor and Memory



Reference1

Reference 2

Jargons

Memory Latency is the time it takes to transfer a word of data to or from memory

Memory Bandwidth is the number of bits or bytes that can be transferred in one second.

Speed vs Size vs Cost

Requirement of Programmers

Programmers want unlimited amounts of memory with low latency

Big challenge

If Size Increases, then Speed Decreases

Funny is

If Size Decreases, then Cost Increases

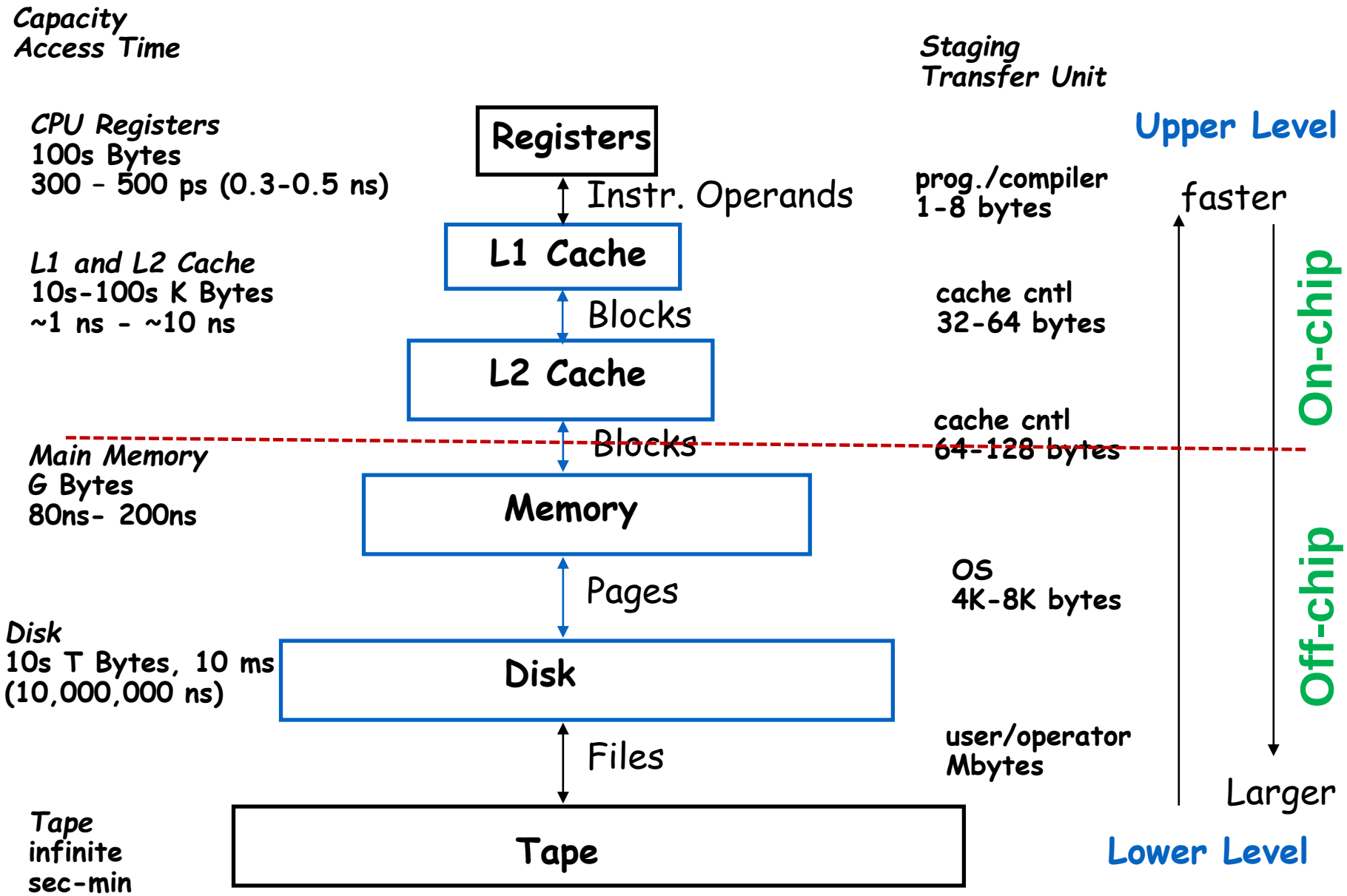
Expected by Designers

To provide a sufficiently large memory, with a reasonable speed at an affordable cost.

Memory Hierarchy

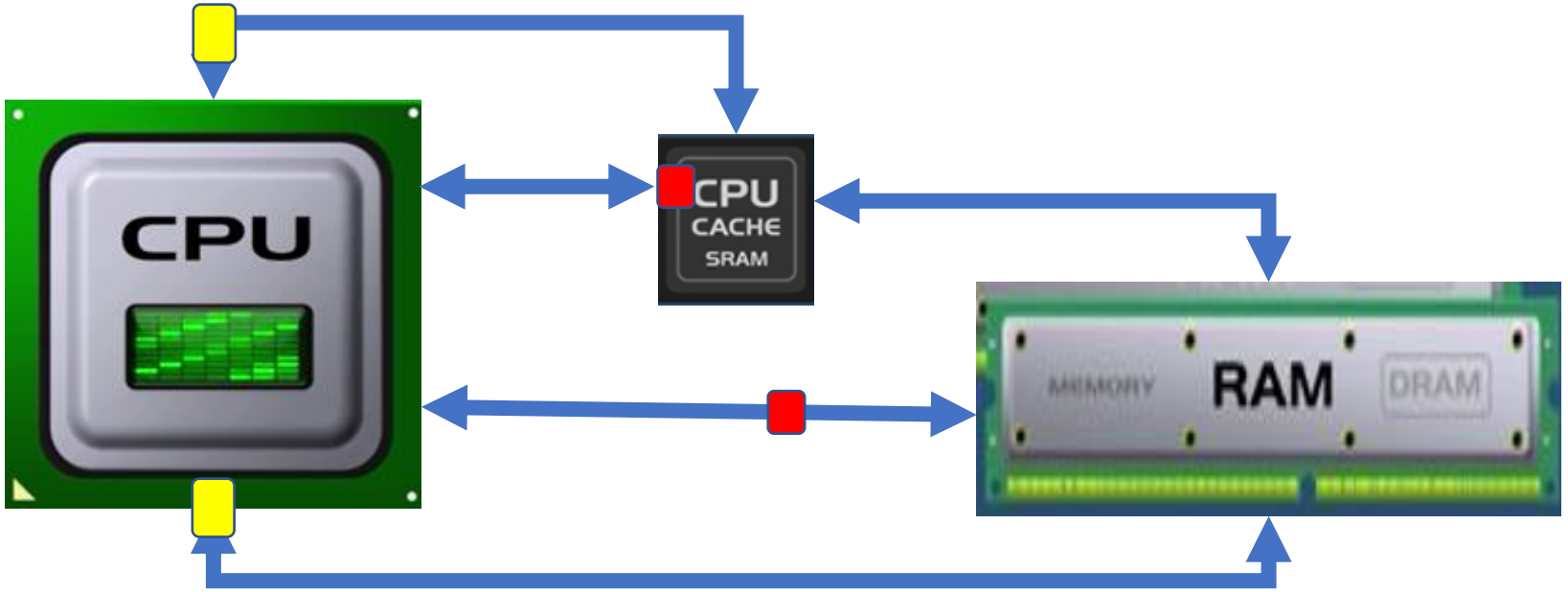
- Organize memory system into a hierarchy
  - Entire addressable memory space available in largest, slowest memory
  - Incrementally smaller and faster memories, each containing a subset of the memory below it, proceed in steps up toward the processor

Memory Hierarchy

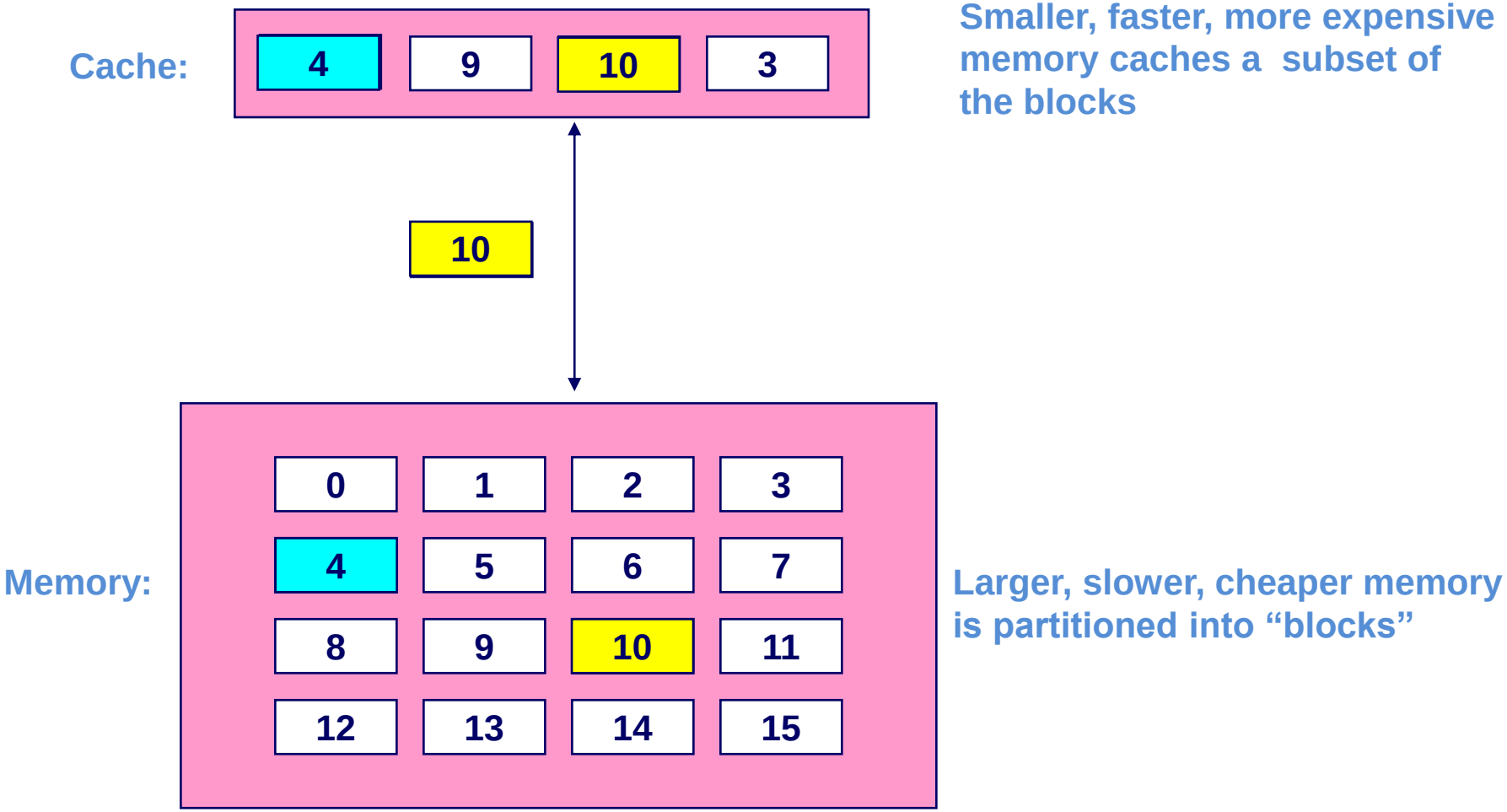


Cache

•Cache memory is an architectural arrangement which makes the main memory appear faster to the processor than it really is.



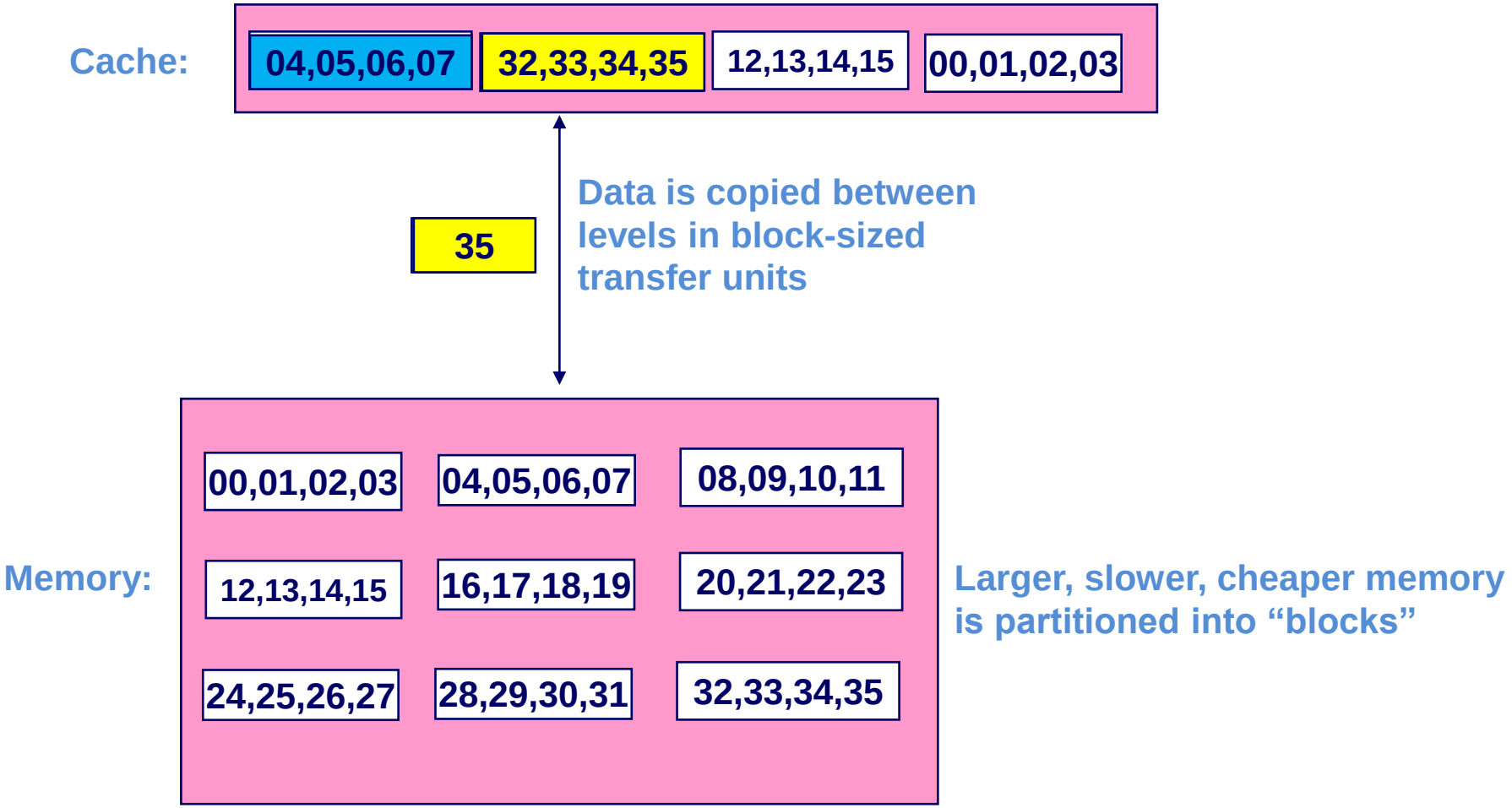
General Cache Mechanics



Smaller, faster, more expensive memory caches a subset of the blocks

Larger, slower, cheaper memory is partitioned into “blocks”

General Cache Requirement



Four Questions in Cache Design

Cache Design is controlled by Four Questions:

Q1: Where can a block be placed in the cache?

- Block Placement

Q2: How is a block found if it is in the cache?

- Block Identification.

Q3: Which block should be replaced on a miss?

- Block Replacement.

Q4: What happens on a write ?

- Write Strategy.

Next Session

Cache Design Principles

THANK YOU

Dr. D. C. Kiran
Department of Computer Science and Engineering

dckiran@pes.edu

9829935135