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Mansoura University
Faculty of Computers and Information
Department of Computer Science

[CS214P] Assembly Language: An Introduction

Grade: Third Year (Computer Science)

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Faculty of Computers and Information,

Mansoura University,

Egypt.

Assembly-Language-Introduction-Lecture 1- Part 1(Fall 2021)
021

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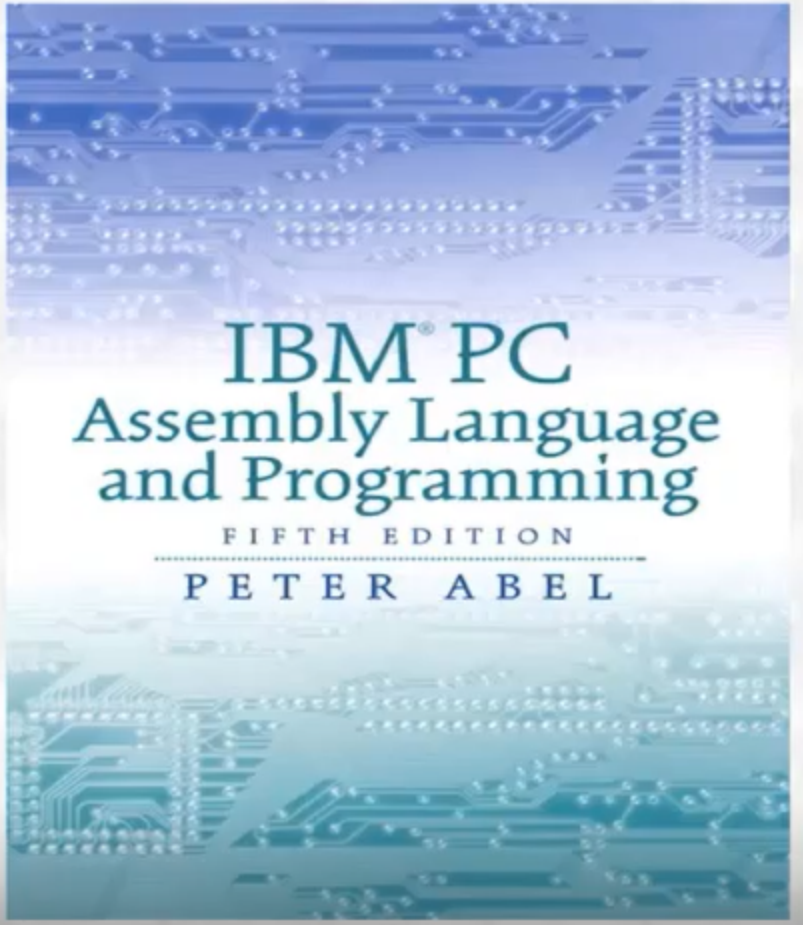
Course outlines

- **Course Text Book:**



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Course outlines

- **Course Labs " materials ":**
  - ➢ Assignments and solving some exercises.
  - ➢ DosBox.
  - ➢ Debug Program.
  - ➢ Emulator 8086.
  - ➢ AE-TASM.
- **Course TA's:**
  - ➢ Eng. Ghada Shafiq

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Course Objectives

- Understand the HW of the personal computer.
- Understand machine-language code and hexa-decimal format.
- Understand the steps involved in assembling, linking, and executing a program.
- Write programs in assembly language to handle the keyboard and screen, perform arithmetic, convert between ASCII and binary formats, perform table searches and sorts, and handle disk I/O.

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Course Objectives

- Trace machine execution as an aid in program debugging.
- Write your own macro instructions to facilitate faster coding.
- Linking separately assembled programs into one executable program.

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Course Requirements

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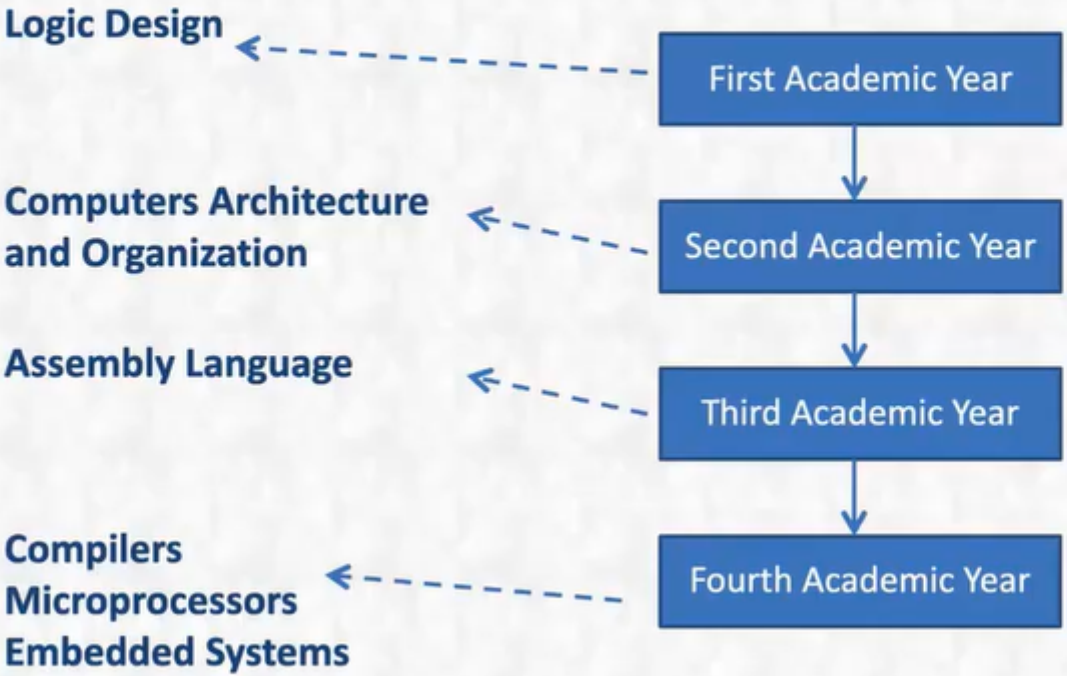
Course Requirements



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Why Assembly? (Knowledge)

- Shows how program interface with operating system, processor and BIOS.
- Show how data is represented and stored in memory and on external devices.
- Show how processors access and execute instructions and how instructions access and process data.
- Show how a program access external devices.

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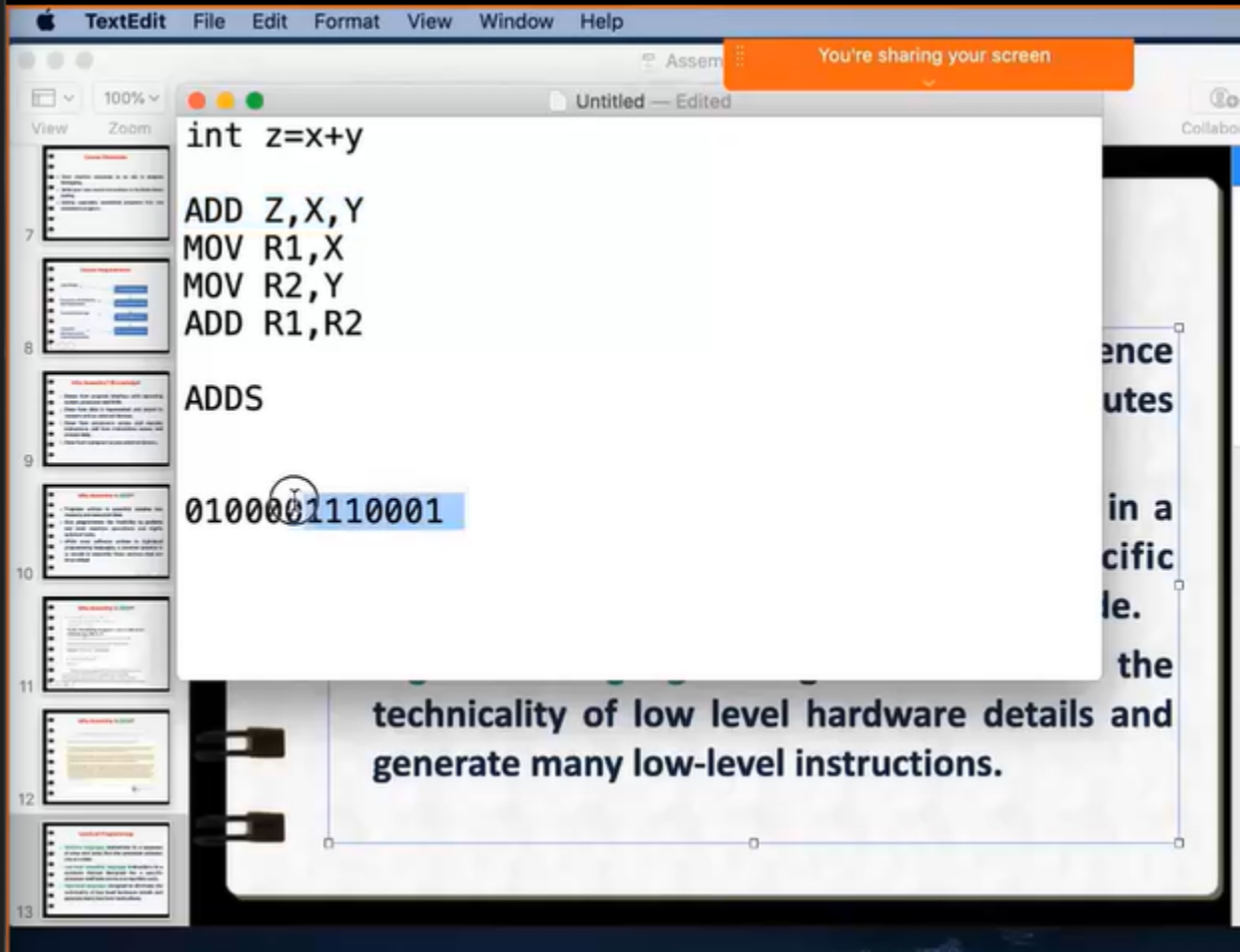
Levels of Programming

- **Machine language**: instructions in a sequence of ones and zeros that the processor executes one at a time.
- **Low-level assembly language**: instructions in a symbolic format designed for a specific processor and have one to one machine code.
- **High-level language**: designed to eliminate the technicality of low level hardware details and generate many low-level instructions.


TextEdit File Edit Format View Window Help
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Untitled — Edited
int z=x+y
ADD Z,X,Y
MOV R1,X
MOV R2,Y
ADD R1,R2
ADDS
0100001110001
technicality of low level hardware details and
generate many low-level instructions.

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Levels of Programming

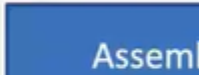
```
unsigned int  bit_seq_i;
unsigned char *bit_seq_buff,
bit_seq_i=16;
```

High-level language

Compiler

```
mov ax, data
mov ds, ax
mov es, ax
mov cx, 10
mov dx, 0
```

Low-level assembly language



Assembler

```
0001100001000010001
0010000010000111100
1001001001100001001
```

Machine language

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What is Assembly Language?

- **Assembly language** is a low-level programming language for a computer or other programmable device specific to a particular computer architecture.
- Each personal computer has a microprocessor that manages the computer's arithmetical, logical, and control activities.
- Each family of processors has its own set of instructions for handling various operations such as getting input from keyboard, displaying information on screen etc.

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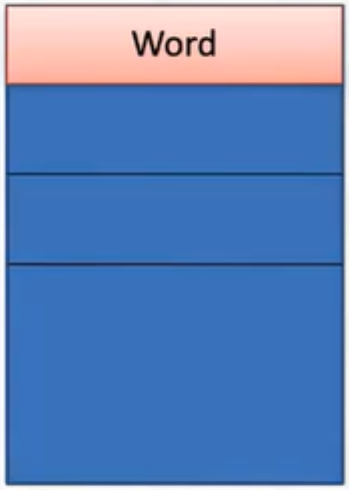
To Start:

You need to know your Computer ?

0101 0000 0000 500H



Memory

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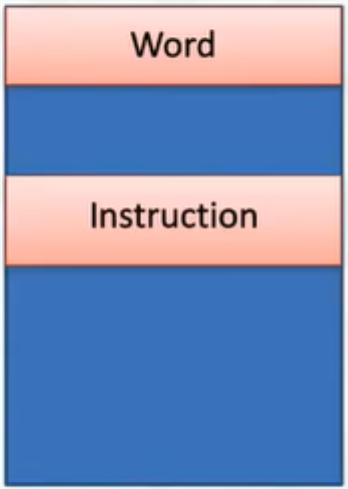
To Start:

You need to know your Computer ?

0101 0000 0000 500H



Memory

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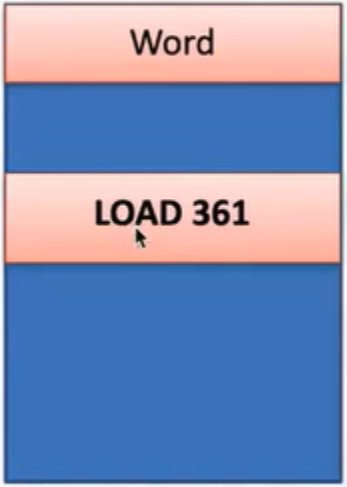
To Start:

You need to know your Computer ?

0101 0000 0000 500H



Memory

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To Start:

You need to know your Computer ?

0101 0000 0000 500H

Memory

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```
ins = 16 bit
inst= opcode + address
16= ?+12
load 361
load 0110

361H=12bit


load 0110
add 1110
sub 0101
```

Memory

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To Start:

You need to know your Computer ?

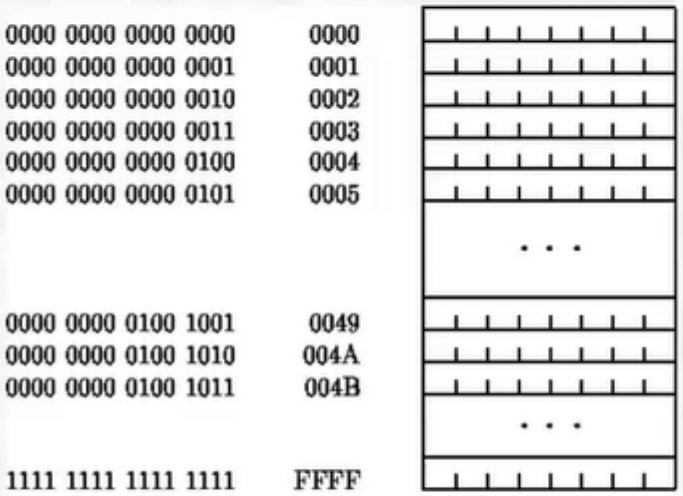
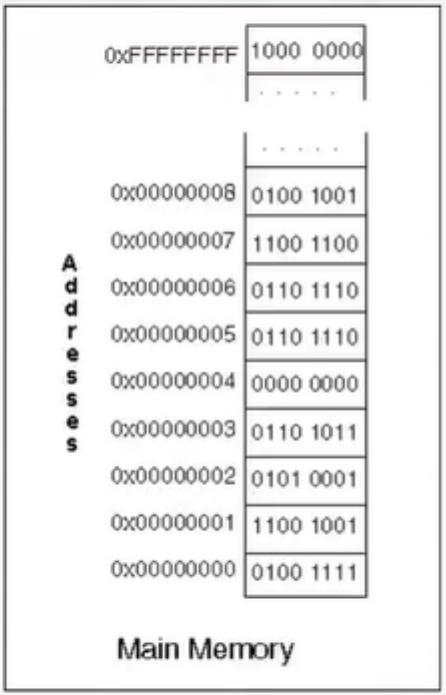


Figure 1.2: Memory and Addresses



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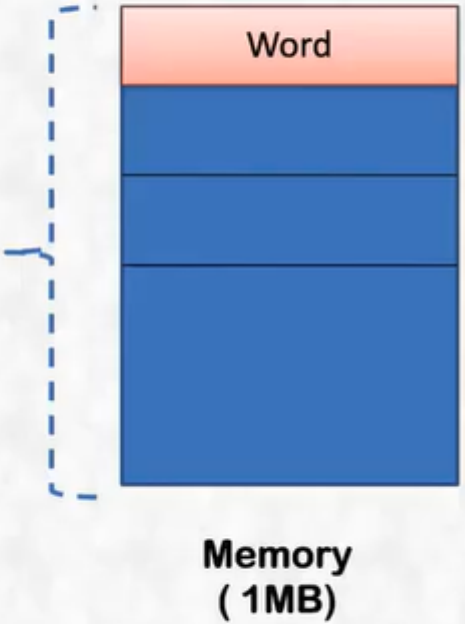

$$memory\ size\ in\ words = \frac{memory\ size\ in\ bits}{word\ size}$$

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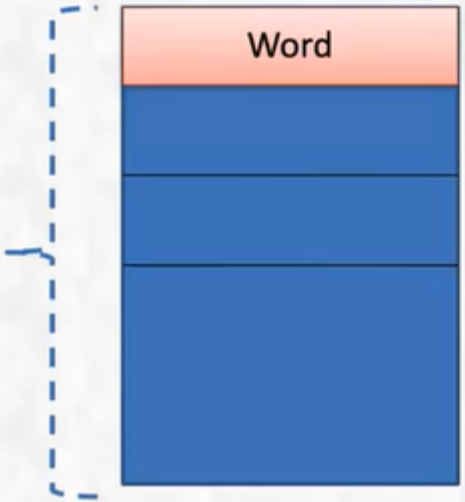
To Start:

You need to know your Computer ?



Memory
(1MB)

$$memory\ size\ in\ words = \frac{memory\ size\ in\ bits}{word\ size}$$

$$memory\ size\ in\ words = \frac{2^{10} \times 2^{10} \times 2^{3}}{2^{3}} = 2^{20}\ words$$

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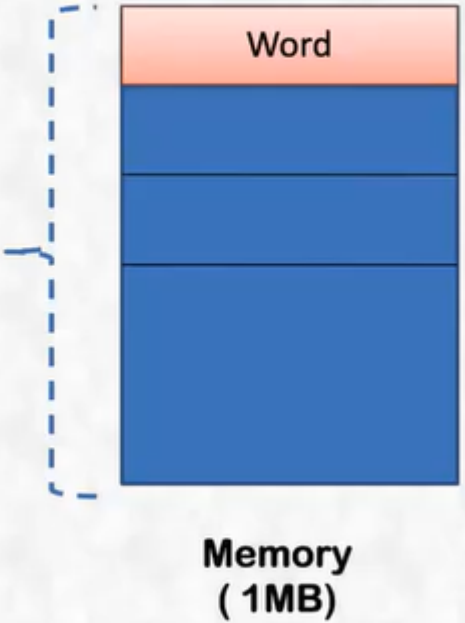
To Start:
You need to know your Computer ?



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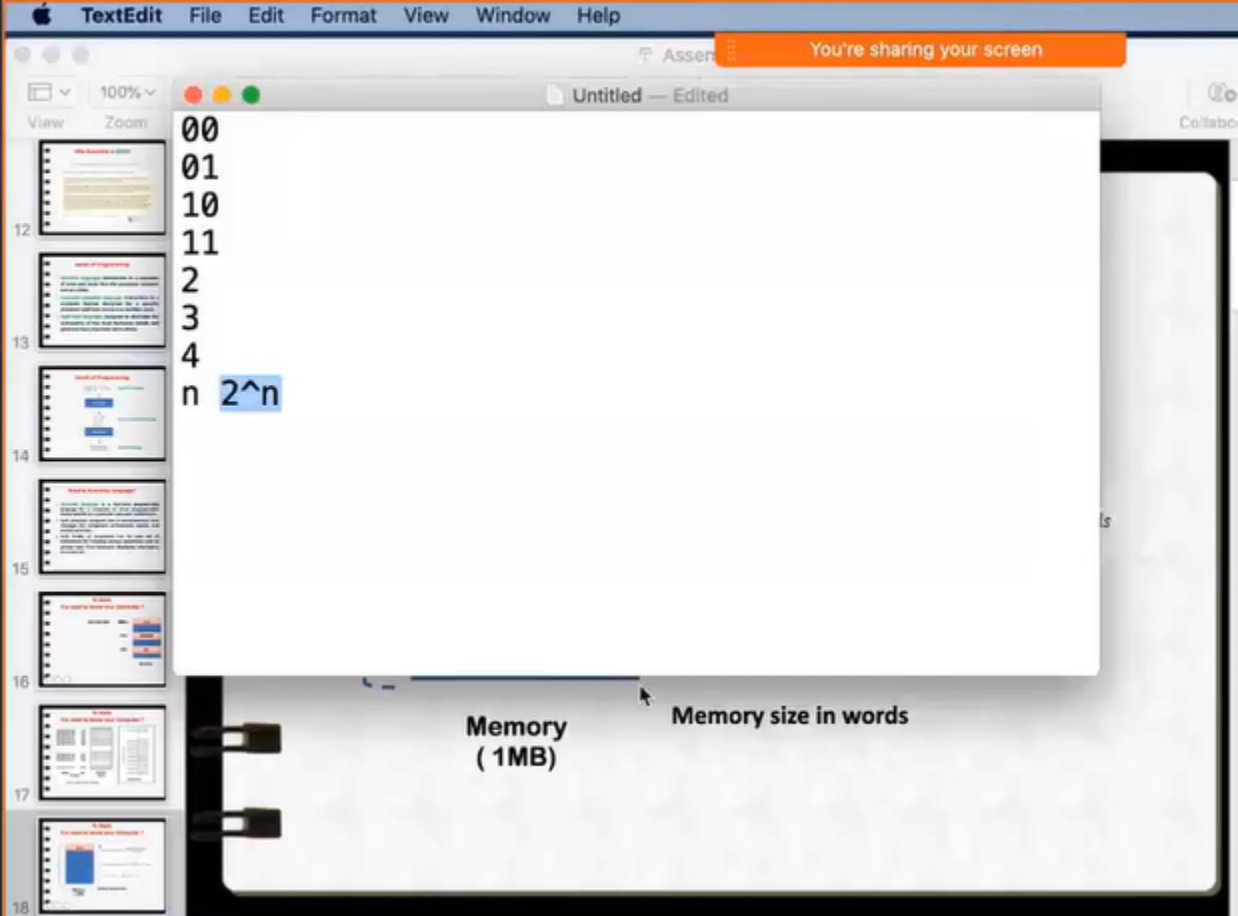
$$memory\ size\ in\ words = \frac{2^{10} \times 2^{10} \times 2^{3}}{2^{3}} = 2^{20}\ words$$

$$\#\ bits\ for\ address = 2^{20}\ words = 20\ bits$$


TextEdit File Edit Format View Window Help
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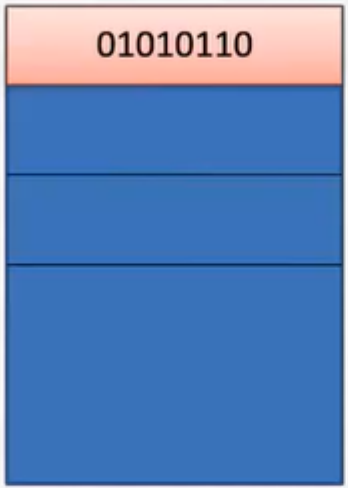
00
01
10
11
2
3
4
n 2^n
Memory
(1MB)
Memory size in words

You're sharing your screen

To Start:

You need to know your Computer ?



Memory
(1MB)

0001 0001 0010 0010 1111

0x1122F

$$memory\ size\ in\ words = \frac{memory\ size\ in\ bits}{word\ size}$$

$$memory\ size\ in\ words = \frac{2^{10} \times 2^{10} \times 2^{3}}{2^{3}} = 2^{20}\ words$$

$$\#\ bits\ for\ address = 2^{20}\ words = 20\ bits$$

You're sharing your screen

To Start:

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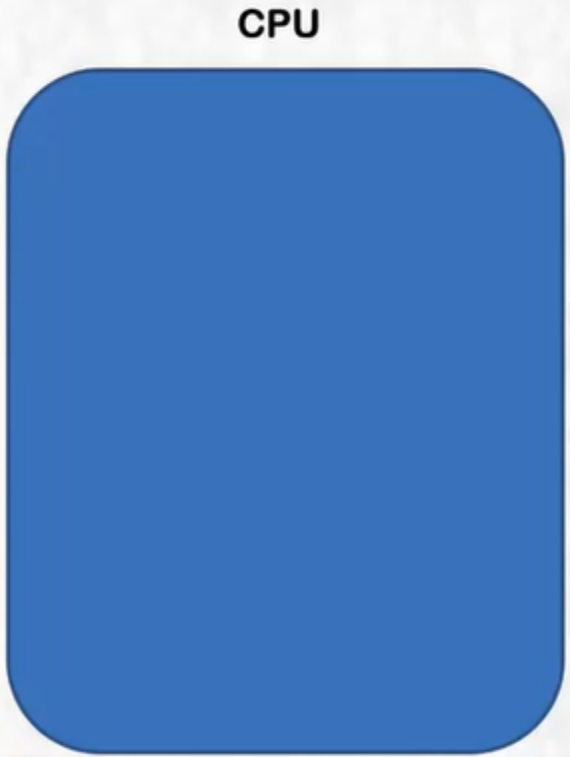

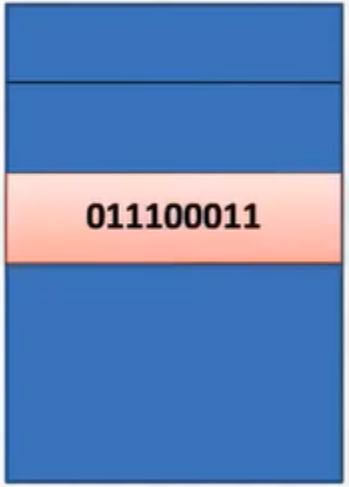

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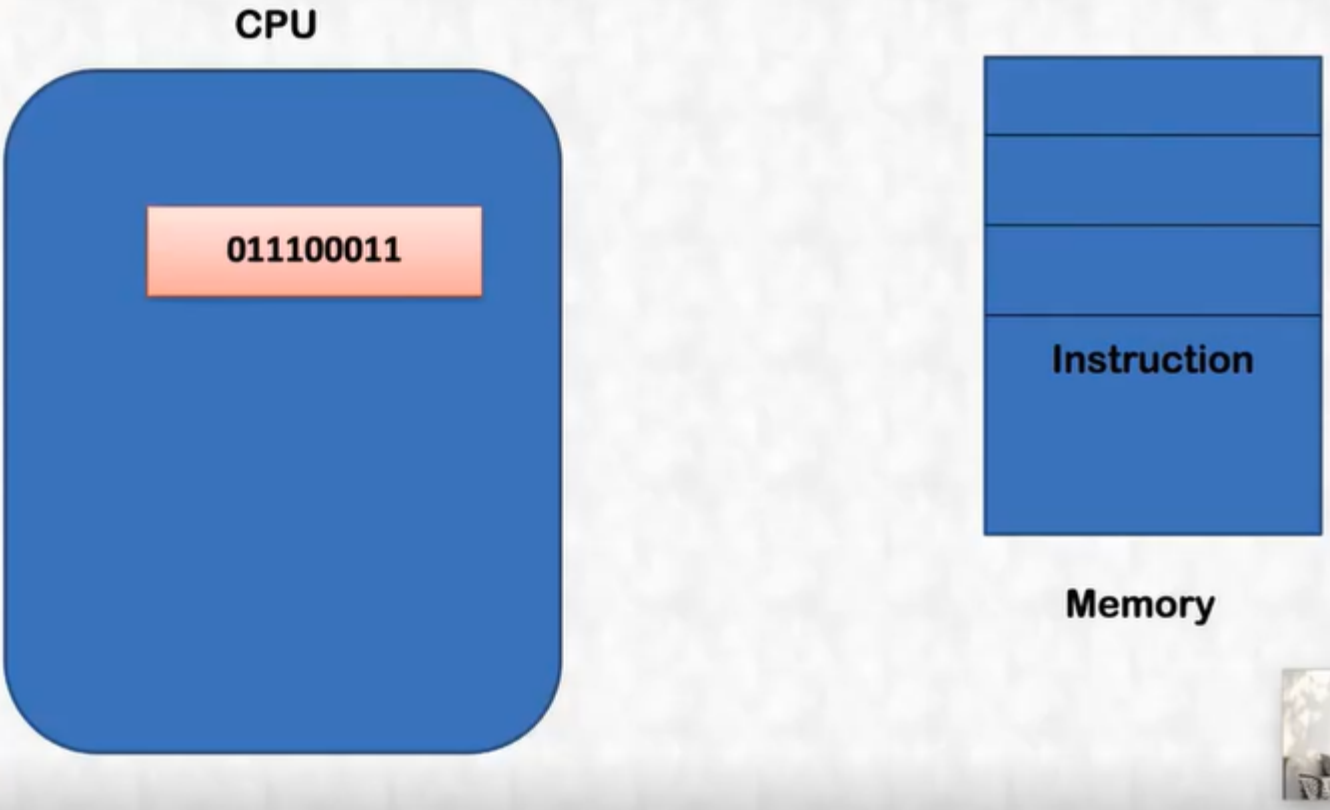

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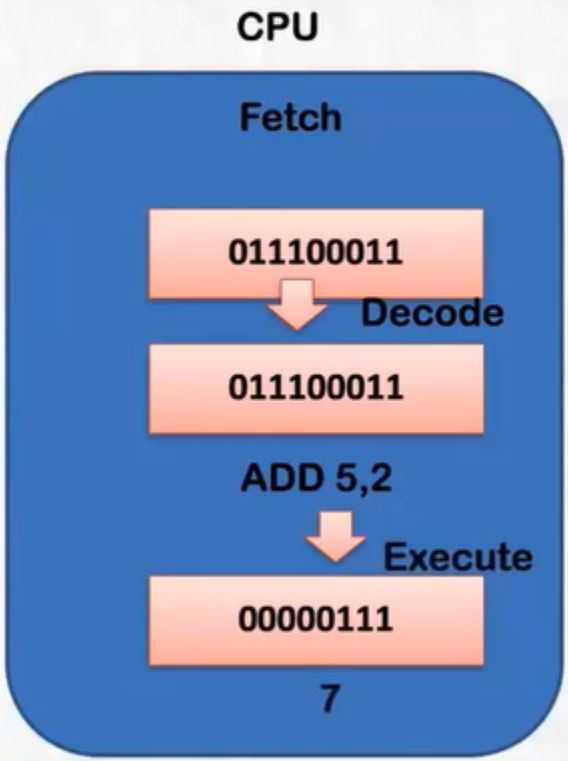

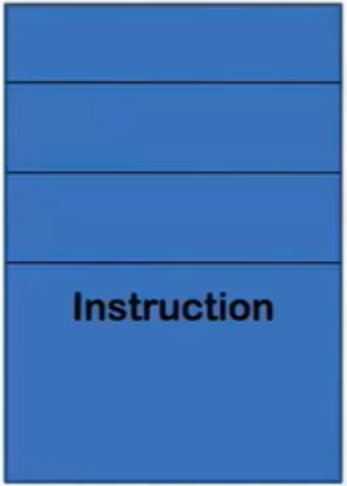

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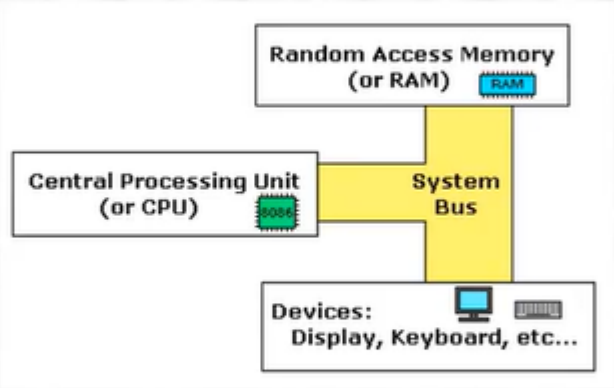

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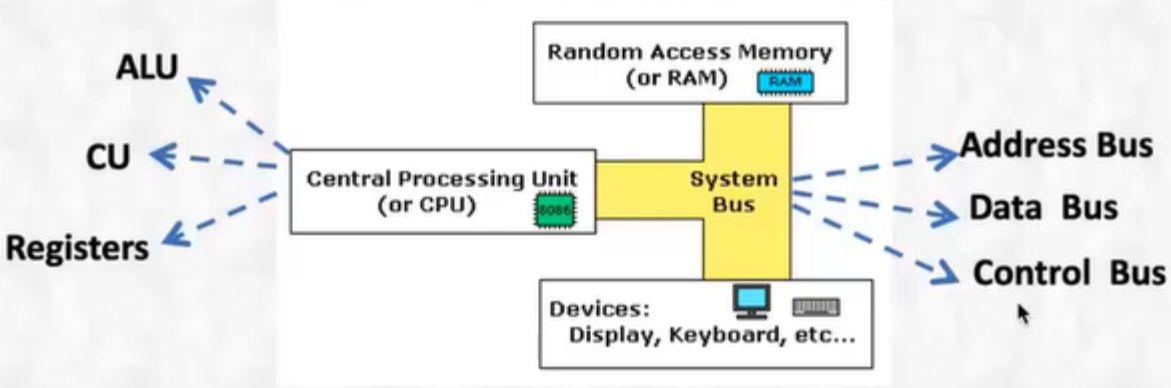

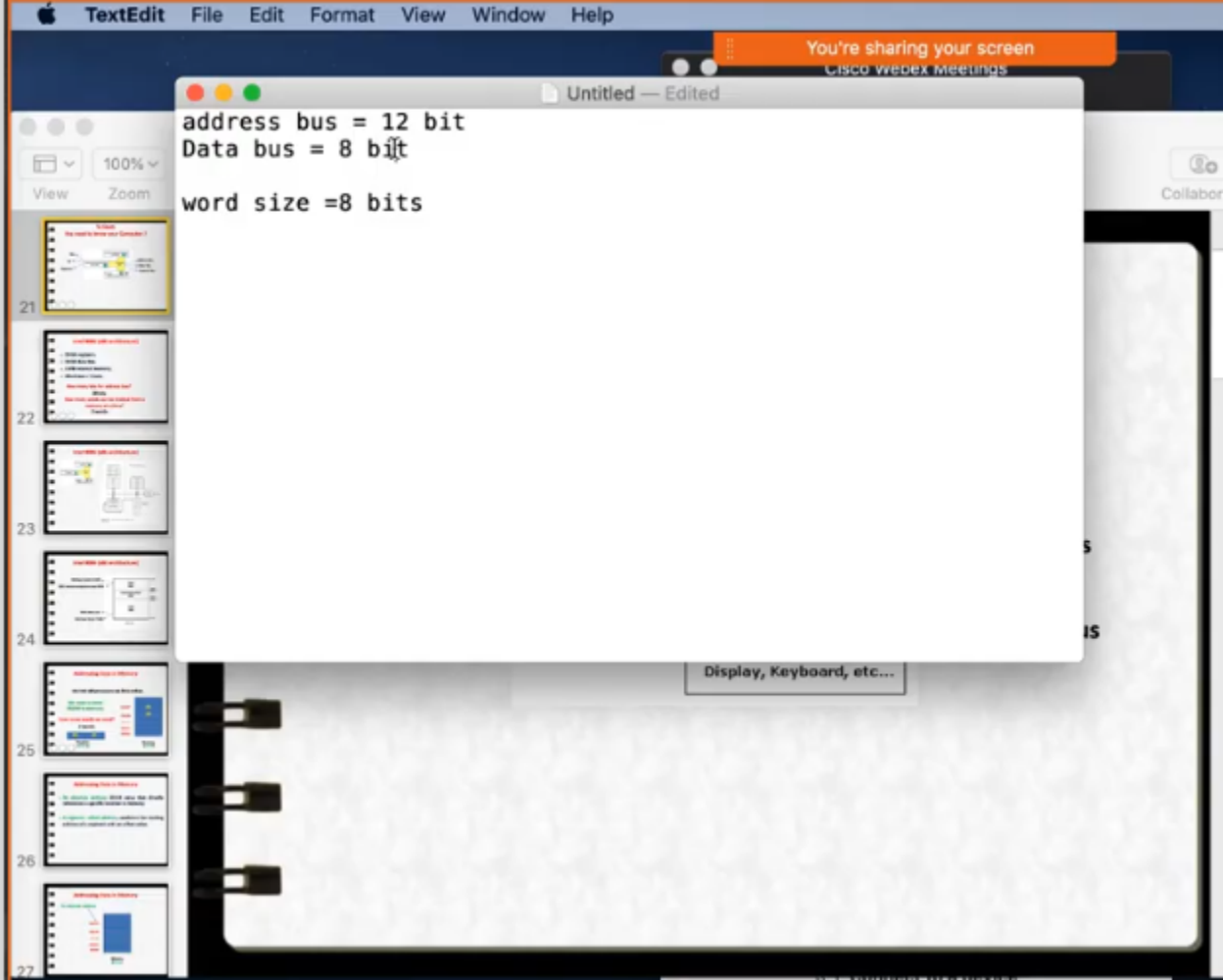
TextEdit File Edit Format View Window Help
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Cisco Webex Meetings
Untitled — Edited
address bus = 12 bit
Data bus = 8 bit
word size =8 bits
Display, Keyboard, etc...

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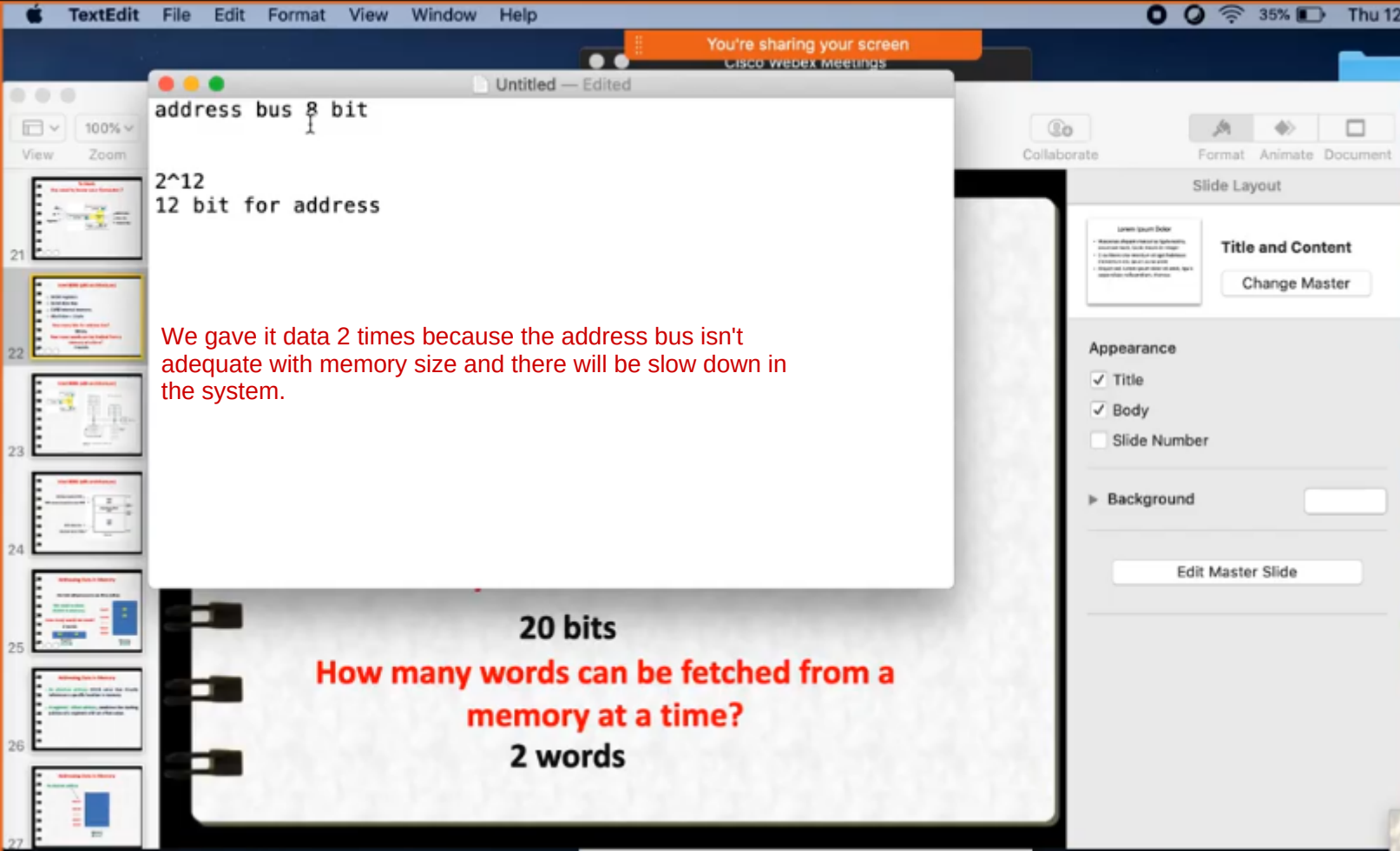
Intel 8086 (x86 architecture)

- 16-bit registers.
- 16-bit data bus.
- 1 MB internal memory.
- Word size = 1 byte.


TextEdit File Edit Format View Window Help
35% Thu 12
You're sharing your screen
Cisco Webex Meetings
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address bus 8 bit
2^12
12 bit for address
We gave it data 2 times because the address bus isn't adequate with memory size and there will be slow down in the system.
20 bits
How many words can be fetched from a memory at a time?
2 words
View
Zoom
Collaborate
Format
Animate
Document
Slide Layout
Title and Content
Change Master
Appearance
Title
Body
Slide Number
Background
Edit Master Slide

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Intel 8086 (x86 architecture)

- 16-bit registers.
- 16-bit data bus.
- 1 MB internal memory.
- Word size = 1 byte.

How many bits for address bus?

20 bits

How many words can be fetched from a memory at a time?

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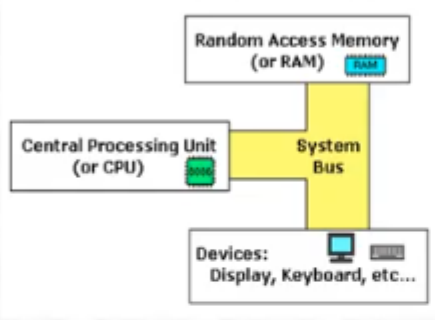
Intel 8086 (x86 architecture)



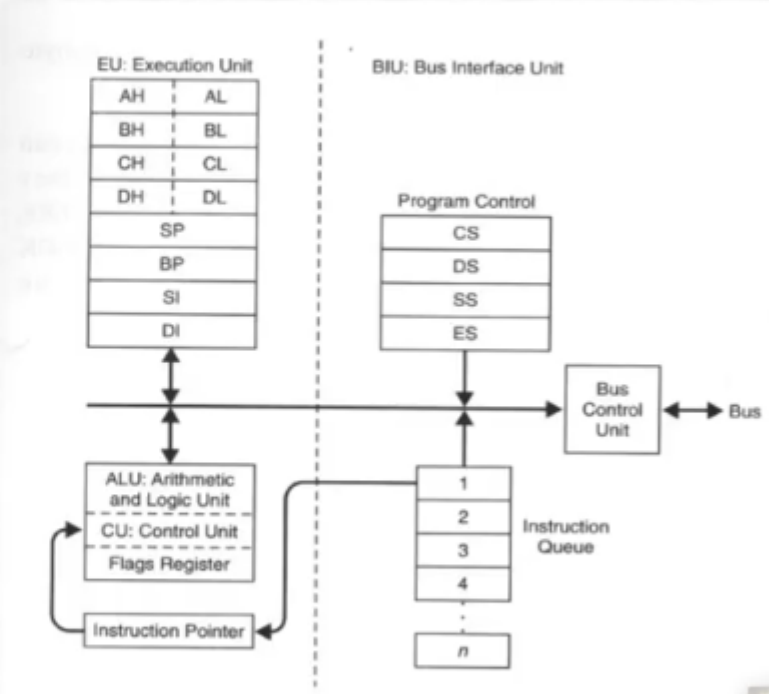


Figure 1-2 Execution Unit and Bus Interface Unit

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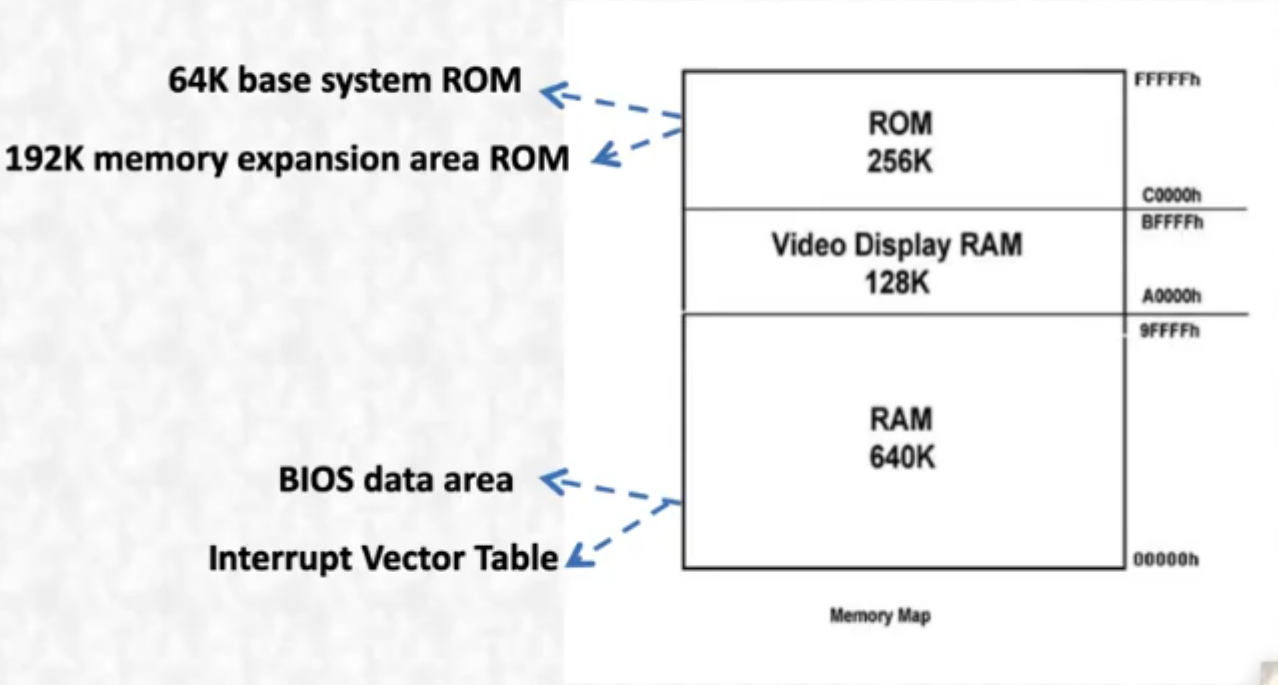
Intel 8086 (x86 architecture)



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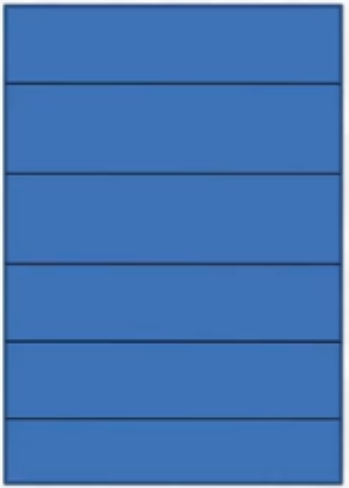
Addressing Data in Memory

the Intel x86 processors use little-endian.

We need to store
0529H in memory

Register
(Queue)



Memory
(Stack)

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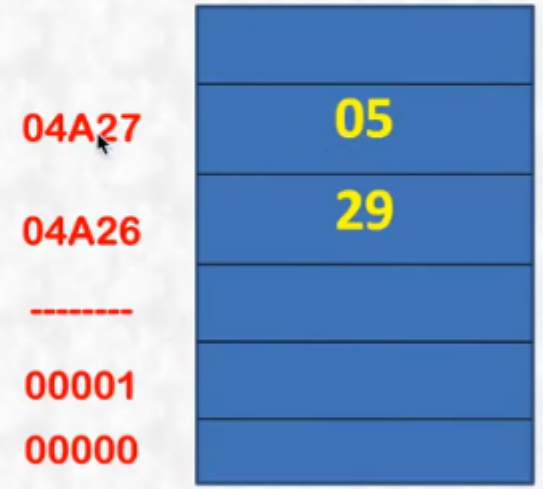

Memory
(Stack)

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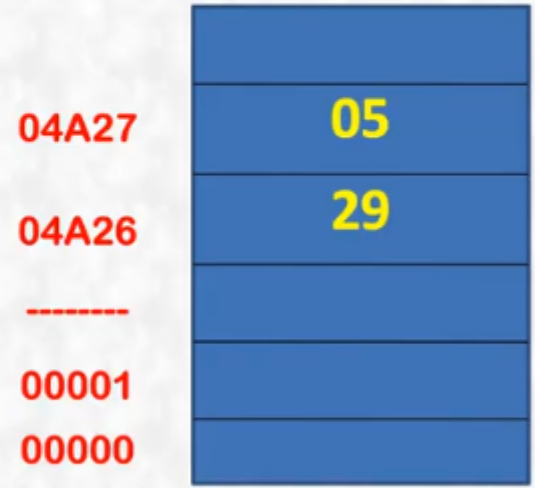
(Queue)



Memory
(Stack)