



Digital Circuit Design

數位電路設計

單智君

Dept. of Computer Science

NCTU

Spring 2021

J.J. Shann



Class & Office

◆ Class:

Wed. 34, Fri. 78 (EC022)

◆ Office:

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◆ Office Hours:

– Wed. 1:30PM~3:00PM



Teaching Assistant & TA Hours

◆ 潘冠蓁學姐 pennypan644@gmail.com

◆ 陳芷羚學姐 vivian96385@gmail.com

◆ 胡雨芳學姐 yuko29.cs07@nctu.edu.tw

◆ TA Hours: EC619

– 胡雨芳學姐 Tue. 6:30PM~8:30PM

– 陳芷羚學姐 Wed. 6:30PM~8:30PM

– 潘冠蓁學姐 Thur. 6:30PM~8:30PM



Prerequisite

- ◆ Prerequisite:

- Binary numbers

- Limited familiarity with a programming language



Textbook & References

◆ Textbook:

M. Morris Mano and Michael D. Ciletti, *Digital Design*,
6th ed., 2018, Prentice Hall. (Ch1~7)

◆ References:

M. Morris Mano and Michael D. Ciletti, *Digital Design*,
4th/5th ed., 2007/2013, Prentice Hall.

M. Morris Mano & Charles R. Kime, *Logic and
Computer Design Fundamentals*, Prentice Hall.

Charles H. Roth, Jr., *Fundamentals of Logic Design*,
Thomson.

Randy H. Katz & Gaetano Borriello, *Contemporary
Logic Design*, Prentice Hall.



Course Contents

- ◆ Digital Systems and Binary Numbers (Ch1)
- ◆ Boolean Algebra and Logic Gates (Ch2)
- ◆ Gate-Level Minimization (Ch3)
- ◆ Combinational Logic (Ch4)
- ◆ Synchronous Sequential Logic (Ch5)
- ◆ Registers and Counters (Ch6)
- ◆ Memory and Programmable Logic (Ch7)
- ◆ Design at the Register Transfer Level (Ch8)
- ◆ Asynchronous Sequential Logic (Ch9, 4th ed)

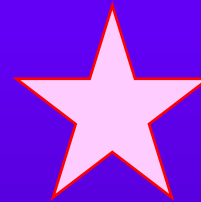


Grading Policy & Course Information

◆ Grading Policy:

– Lab Units/Quizzes/Homework: 20% ~ 40%

- Lab Units: 3~4 (**Verilog**)
- Quizzes: 8~12 (?)
- Homework: ... (?)



* 因應疫情，
彈性調整！

– Examinations: 3, 60% ~ 80%

* The 6th, 11th, 16th weeks

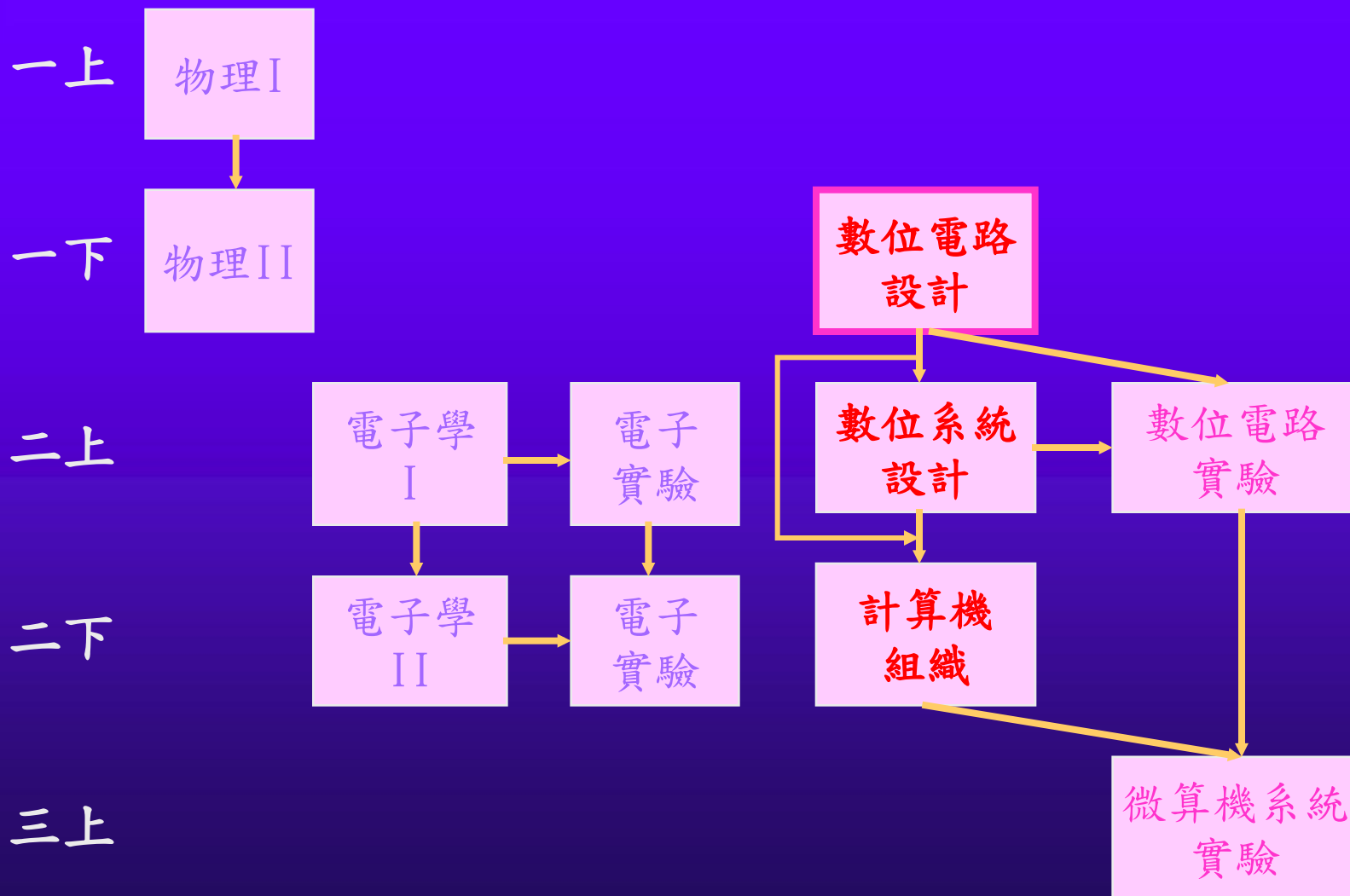
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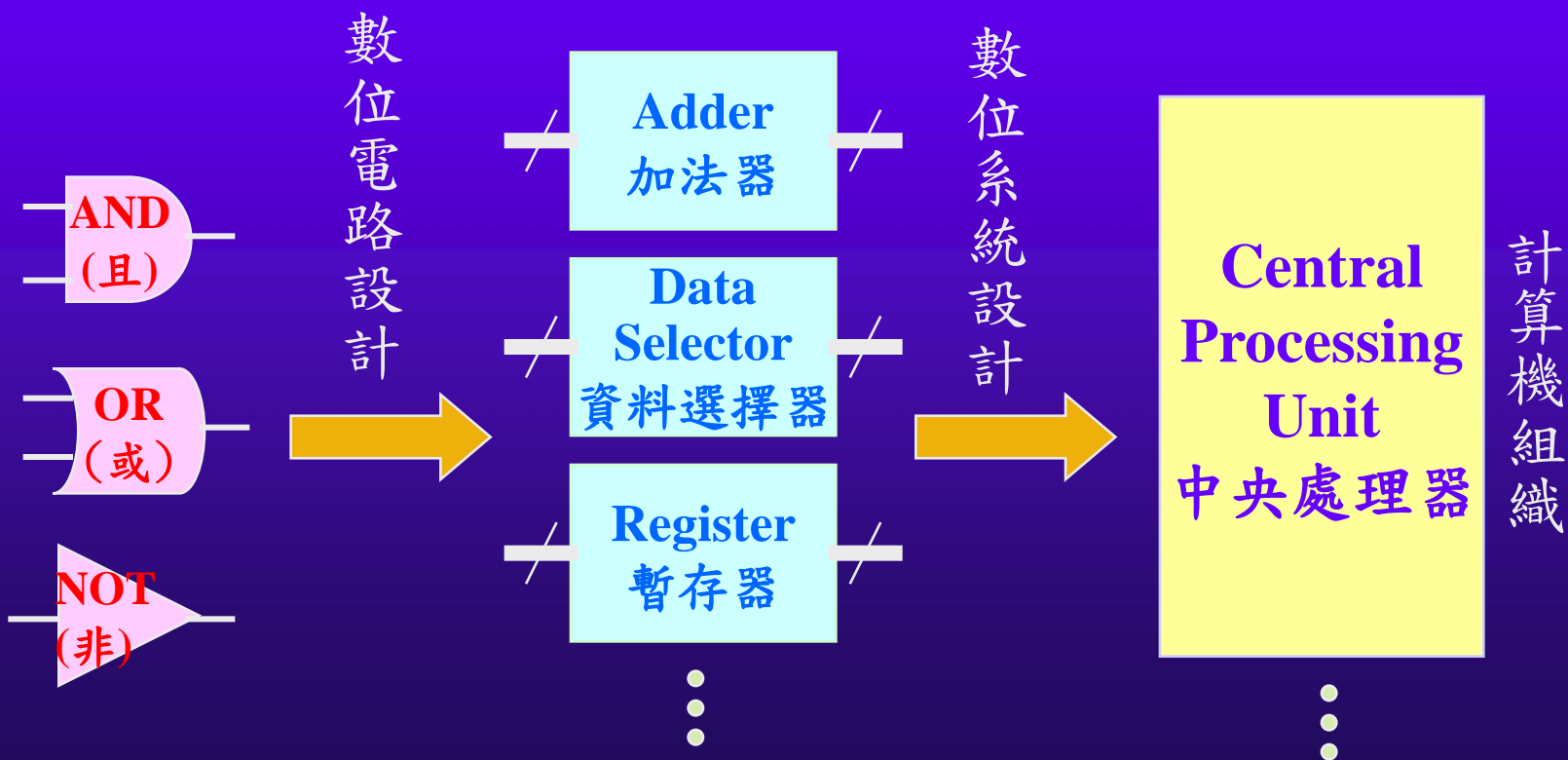
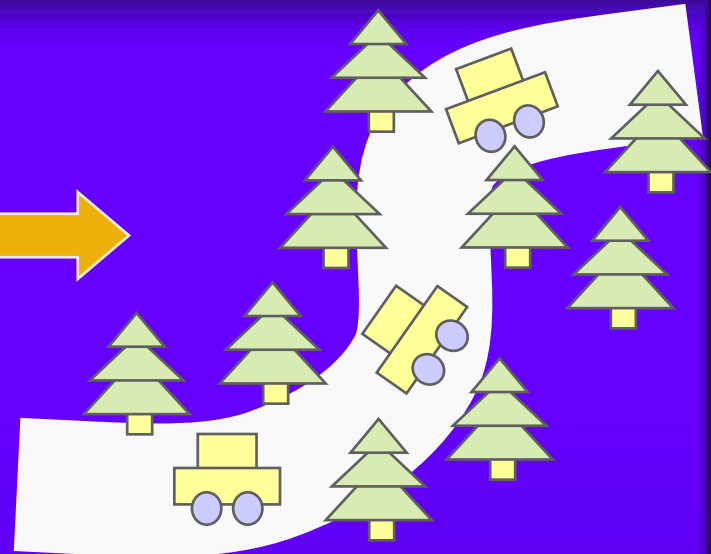
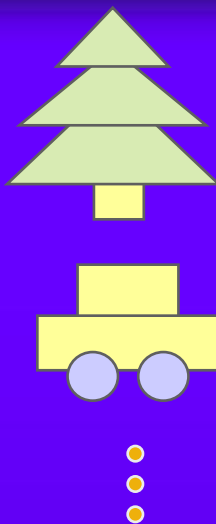
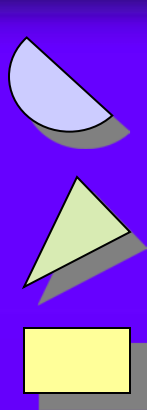
– Participation/Advancement

◆ Course Information:

<https://e3.nycu.edu.tw> (e3 數位教學平台)

課程關聯—計算機硬體基礎課程







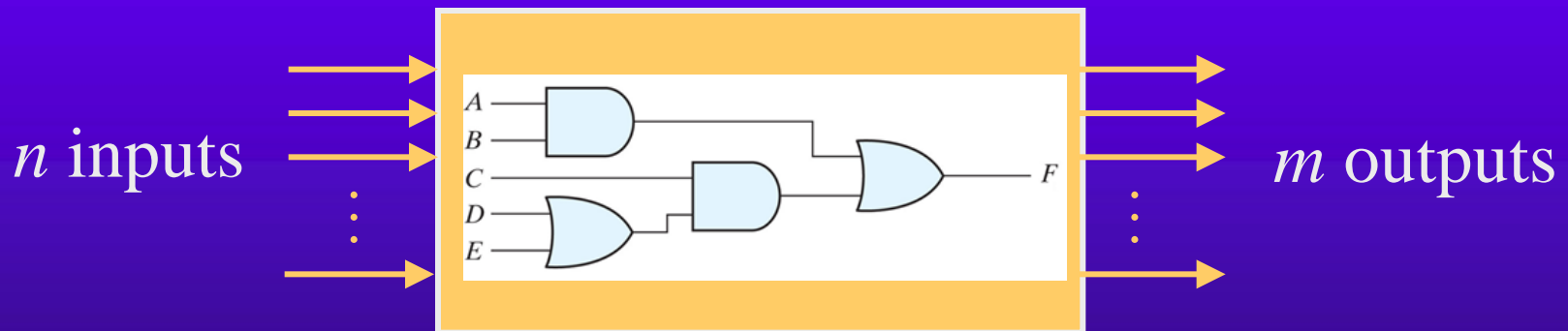
Overview of Digital Circuits

- ◆ Combinational circuits
- ◆ Sequential circuits
 - Synchronous sequential circuits
 - Asynchronous sequential circuits

Combinational Circuits

- ◆ Combinational ckt: logic gates
 - It outputs at any time are determined from the **present inputs**. (no feedback paths or memory elements)

$(\text{inputs}) \Rightarrow (\text{outputs})$



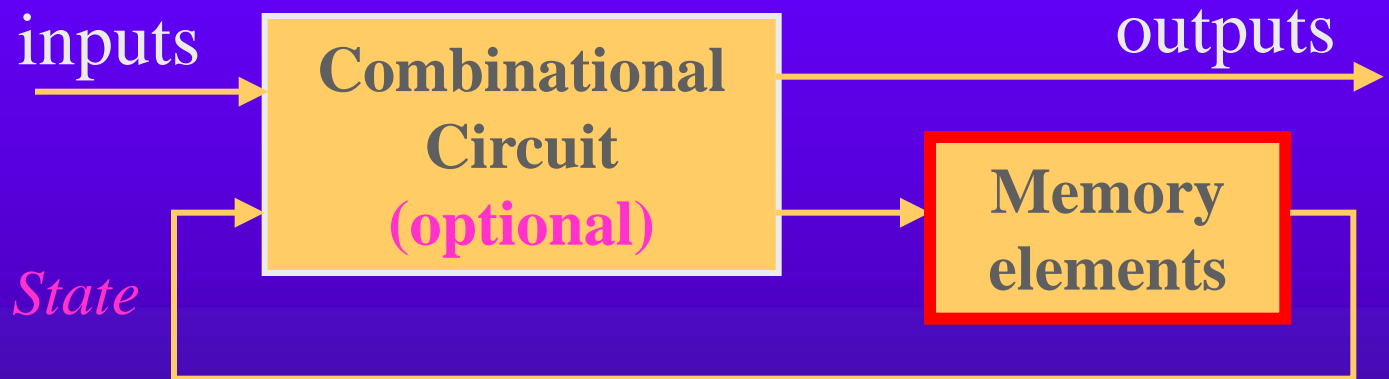
- ◆ Examples:
 - Parallel adder, Encoder, Decoder, Multiplexer, ...



Sequential Circuits

- ◆ Sequential circuit:

$(\text{inputs, present state}) \Rightarrow (\text{outputs, next state})$



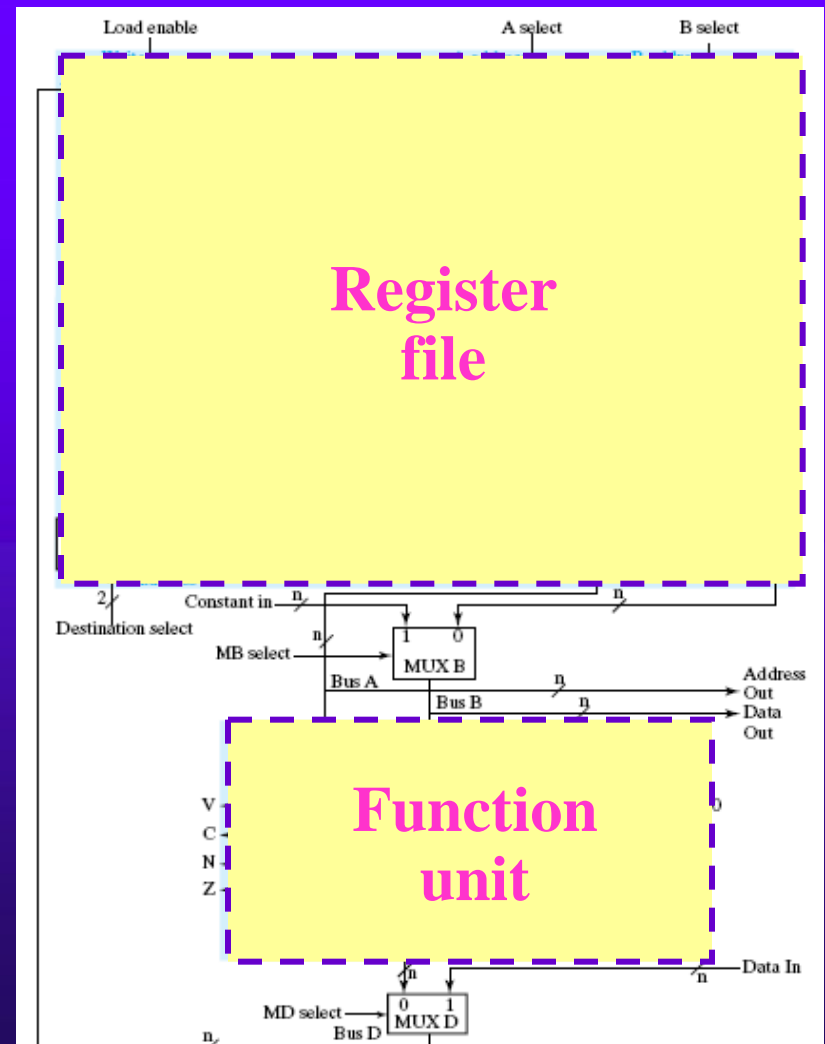
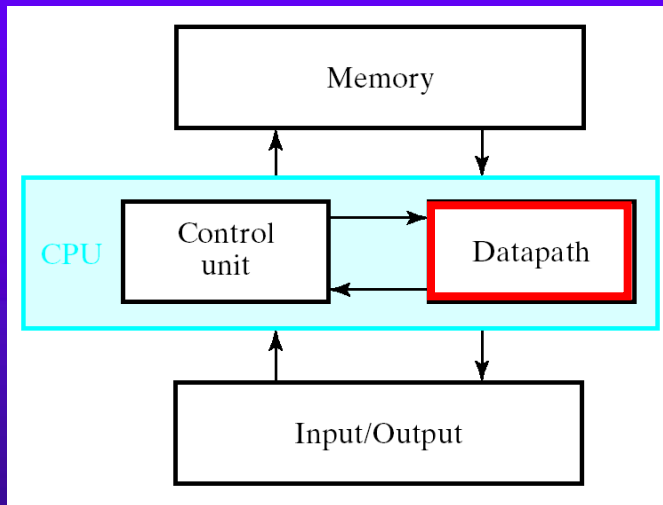
Memory elements: devices capable of storing binary information
(*states*)

- ◆ Synchronous vs. Asynchronous

- ◆ Examples: Vendor machine, Serial adder, ...

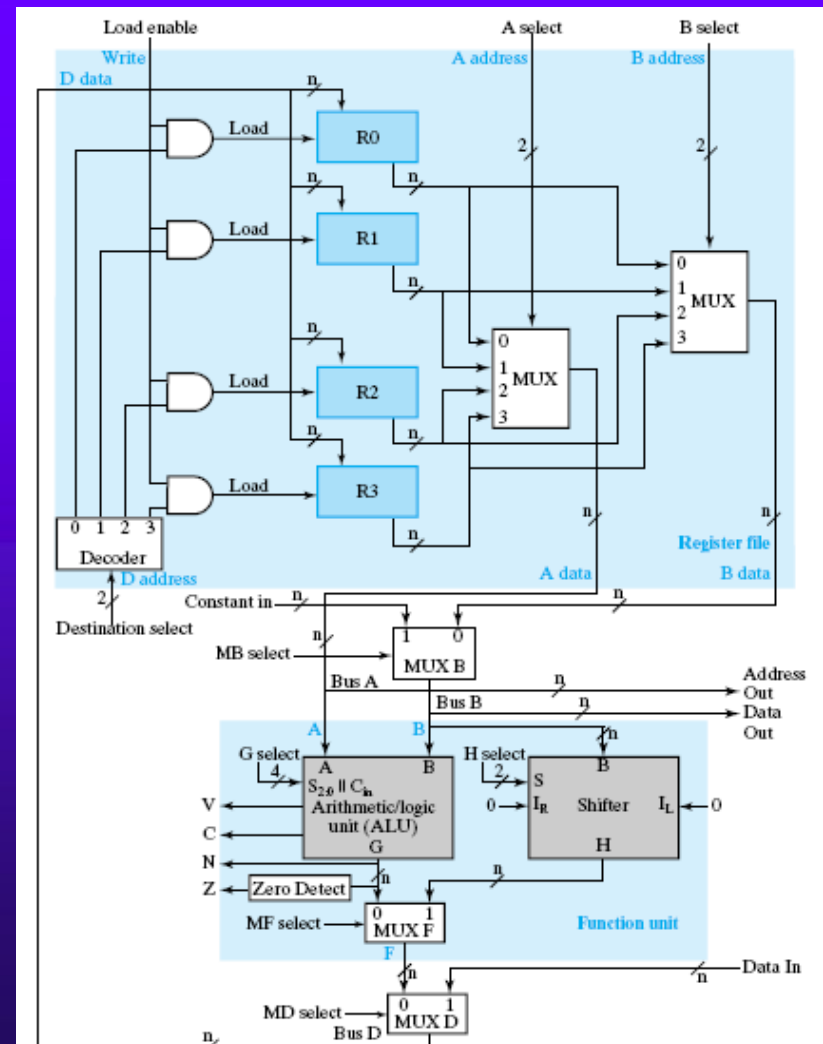
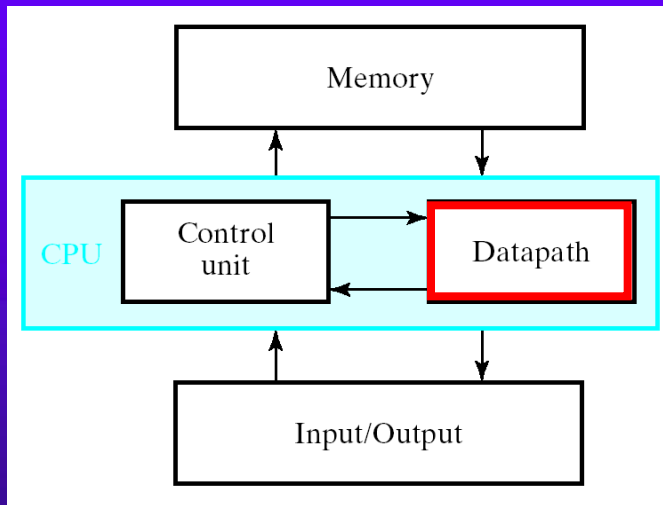
An Example of Digital Systems

◆ Digital computer:



An Example of Digital Systems

◆ Digital computer:





Revolution in Hardware Design

- ◆ Pervasive use of software tools to assist in the process of hardware design
 - Hardware description language (HDL)
 - Computer-aided design tools
 - * Hardware design looks like software design
- ◆ Emergence of rapid implementation circuit technology
 - Programmable logic

