FPG系統設計

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Syllabus (1/2)

- Time and Place
  - Tuesday : 9:10 ~ 12:00 Rm.4285
- Contact Information
  - Rm.4216 (06-2757575 EXT 62547)
  - E-mail: pychen@csie.ncku.edu.tw
- Office Hour
  - Monday: 8:00~12:00
- Assistants
  - Rm. 4244 數位IC設計實驗室 林宜民

Syllabus (2/2)

評分方式: 考試(40~50%)

作業含Demo(50~40%)

平常成績(10%)

參考書目：

1. 教育部P&L聯盟課程講義– FPGA系統設計實務
2. HDL chip design (Douglas J. Smith), Doone Publications
3. Principles of digital design (Daniel D. Gajski), Prentice Hall
4. Modeling, synthesis, and rapid prototyping with the Verilog HDL (Michael. D. Ciletti), Prentice Hall
5. Digital Design (M. Morris Mano), Prentice Hall
6. Verilog 硬體描述語言數位電路設計實務,(鄭信源),儒林

Signal

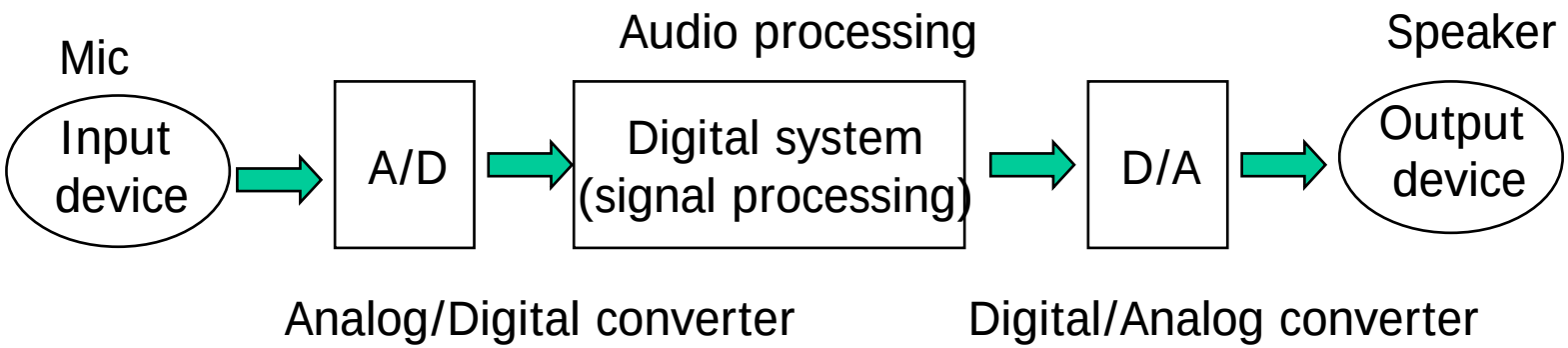
- **Discrete elements of information are represented by physical quantity.**
- **Electrical signals such as voltages and currents are the most common.**
- **Most digital systems use two discrete values (binary). It is easy to realized with the current or voltage.**

  - **digits 0 and 1**
  - **False (F) and True (T)**

  - **Low (L) and High (H)**
  - **On and Off**

Analog and Digital Information

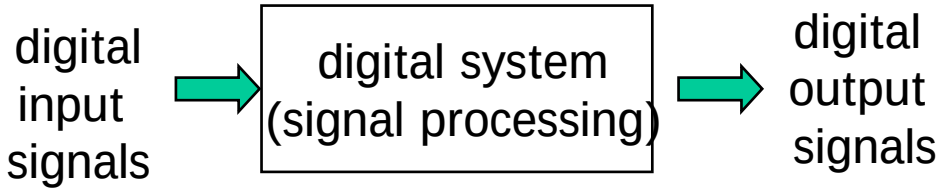
- Most sensors are analog devices.
- Computers, cannot work well with analog information. So we **digitize** information by breaking it into pieces and representing those pieces separately.
- Therefore an analog to digital converter is needed.



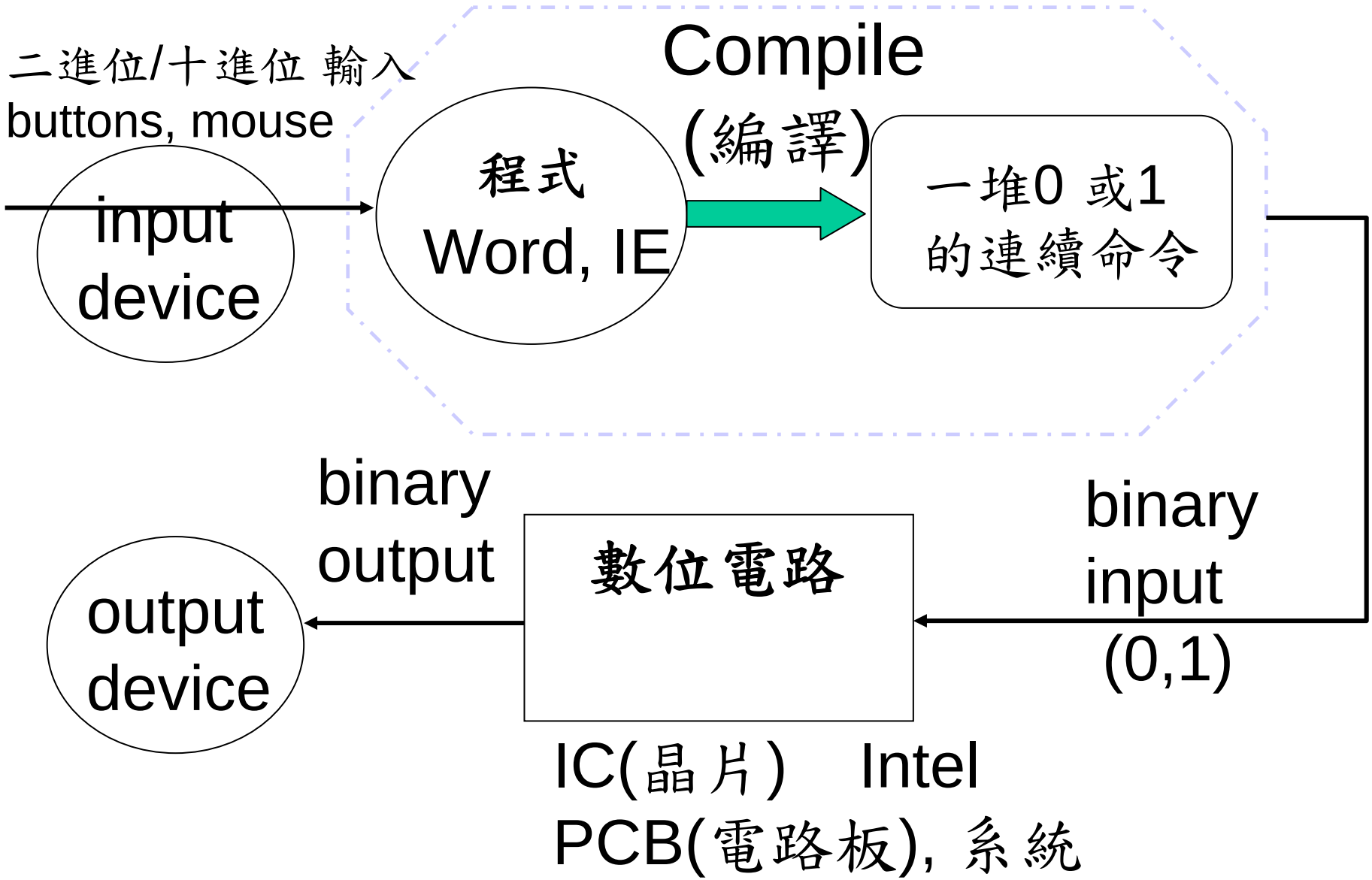
Traditional TV input signals

Digital Systems

- **Present technology period -- Digital Age**
- **Digital systems**
  - **Digital phone**
  - **Digital television**
  - **Digital camera**
  - **Electronic calculators, PDA's**
- **Digital computers**
  - **Follow a sequence of instructions (--program)**
  - **General-purpose for information processing**



Overview of Digital System



Computers and Electricity

- Consumer electronic devices (消費電子裝置) use binary

  range of 0~1 volt is “low” -- binary 0

  range of 2~5 volt is “high” -- binary 1

  Now, many devices use different voltage for power saving.

  Higher voltage and faster frequency need more Power (P)

- **Gate (邏輯閘)** A device that performs a basic operation on electrical signals, accepting one or more input signals and producing a single output signals
- **Circuits (電路)** A combination of interacting gates designed to accomplish a specific logical function (the output of a gate often serves as an input for one or more other gates)

Gate➔ circuits ➔ IC➔PCB➔ System

AND Gate

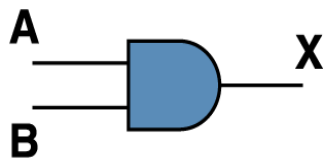
- An AND gate（及閘 或 且閘）accepts two input signals
- If the two input values for an AND gate are both 1, the output is 1; otherwise, the output is 0

Boolean Expression

$$X = A \cdot B$$

$$0 \cdot 0 = 0$$
$$0 \cdot 1 = 0$$
$$1 \cdot 0 = 0$$
$$1 \cdot 1 = 1$$

Logic Diagram Symbol



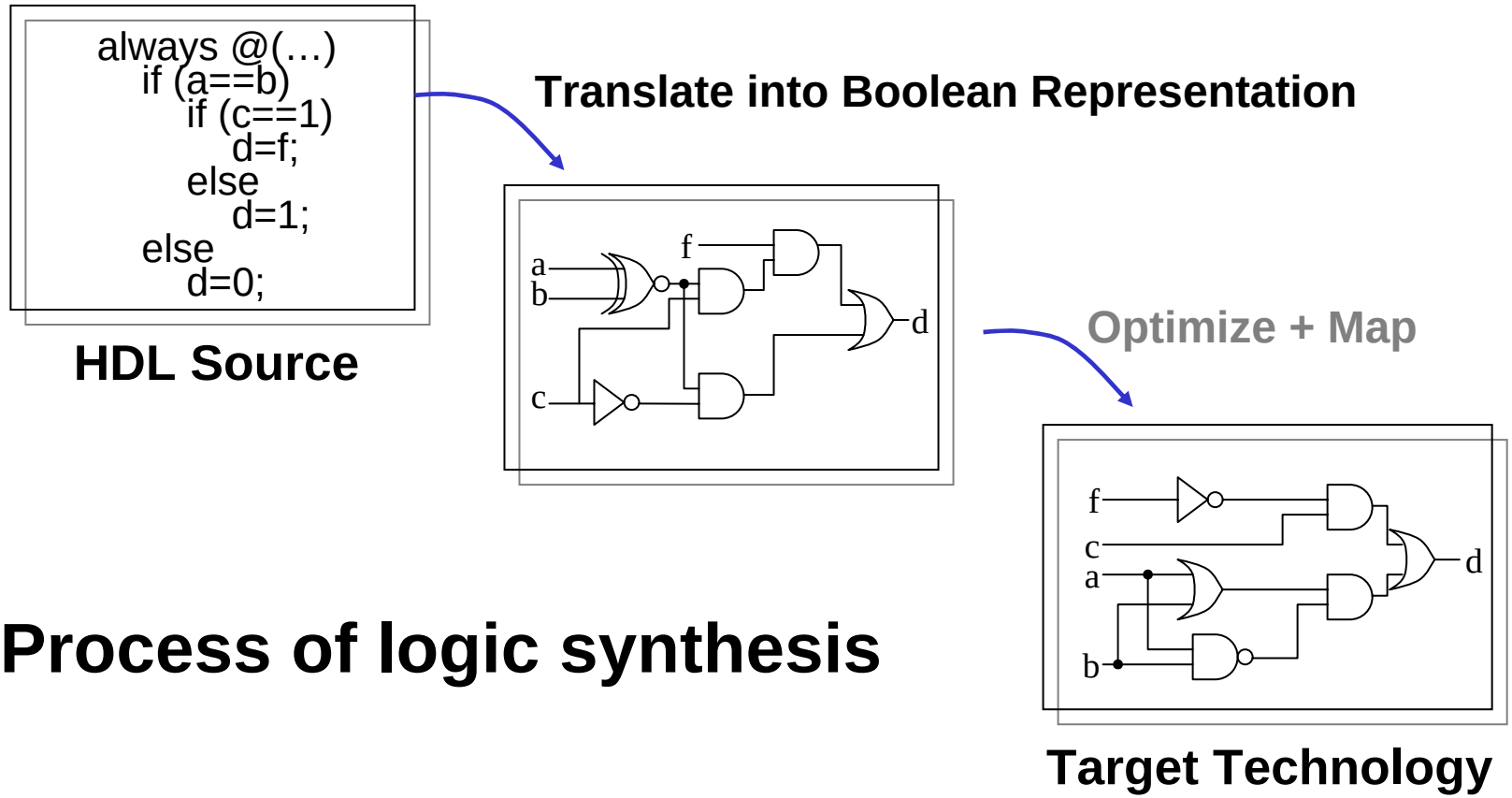
Truth Table

A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

Input output

Synthesis

- *Synthesis = Translation+Optimization+Mapping*



Process of logic synthesis

Hierarchical Components in PCB

1. **Describe the circuits with Hardware Description Language (HDL硬體描述語言)**

2. **Synthesis (合成) the circuits**

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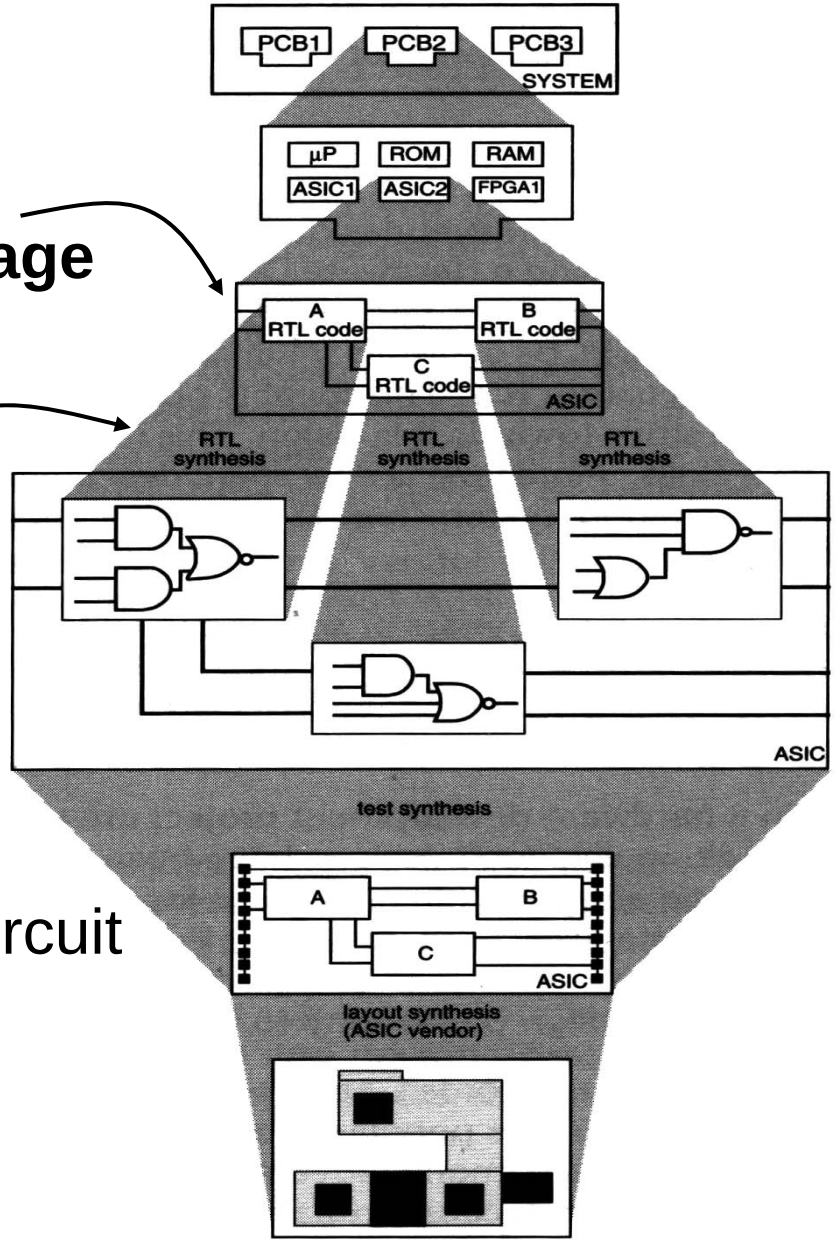
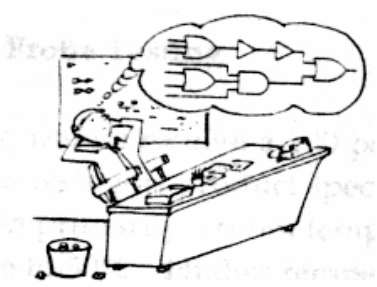
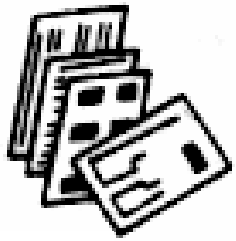


application specific integrated circuit (ASIC晶片)

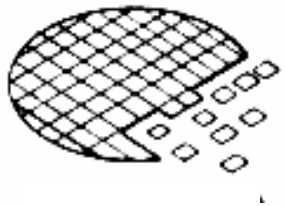
IC Industry in Taiwan



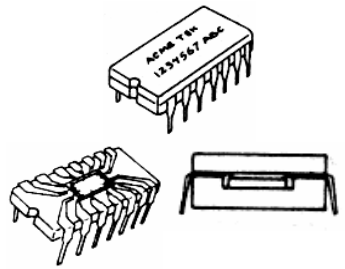
邏輯設計



光罩設計



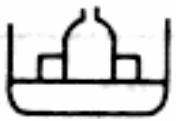
晶粒測試及切割



封　裝

成品測試

設計 → 光罩 → 製造 → 封裝 → 測試



長晶

晶圓切割

晶圓

化學品

導線架

Outline

- **Overview of Digital System**
- **Chapter 1**: Introduction
- **Chapter 2**: Logic Design
- **Chapter 3**: FPGA Design Flow
- **Chapter 4**: RTL Coding
- **Chapter 5**: Digital System Design with Verilog
- **Chapter 6**: Case Study
- **Chapter 7**: System on a Chip
- **Chapter 8**: SoPC