微机原理及应用

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课程说明

本课程是一门机械电子工程专业奠基性的专业基础课。其涉及了微型计算机的基本结构、基本原理、及其应用的基本方法，是学生进行机电一体化产品设计必不可少的专业知识。课程目标如下：

- 1）使学生了解计算机的历史和发展，掌握数字信号处理的基本原理，掌握微电脑的基本结构和微电脑的工作原理，培养学生机械电子专业的素养。**（课程目标1支撑毕业要求1.2）**
- 2）使学生学会汇编语言程序设计，掌握微电脑软、硬件的应用技术，为计算机在机电系统控制方面的应用打下基础。**（课程目标2支撑毕业要求3.2）**
- 3）使学生掌握MCS-51单片微型机的开发实验系统和KEIL 51仿真软件的使用，并且可以应用于复杂机电系统控制。**（课程目标3支撑毕业要求5.1）**

Introduction to Embedded Systems and Computing

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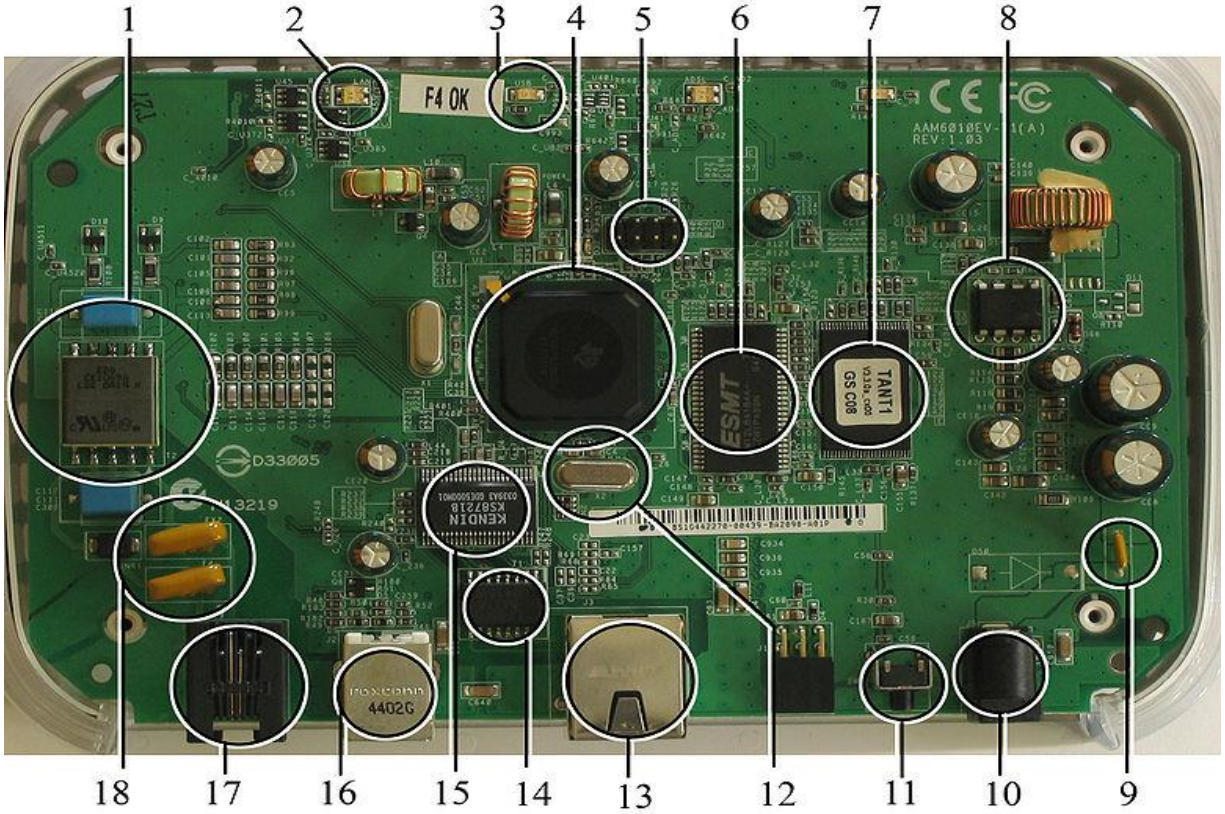
OUTLINE

- Introduction to embedded systems
- Introduction to computing

- Definition
- Examples
- Microprocessors vs microcontrollers
- Classification of processors

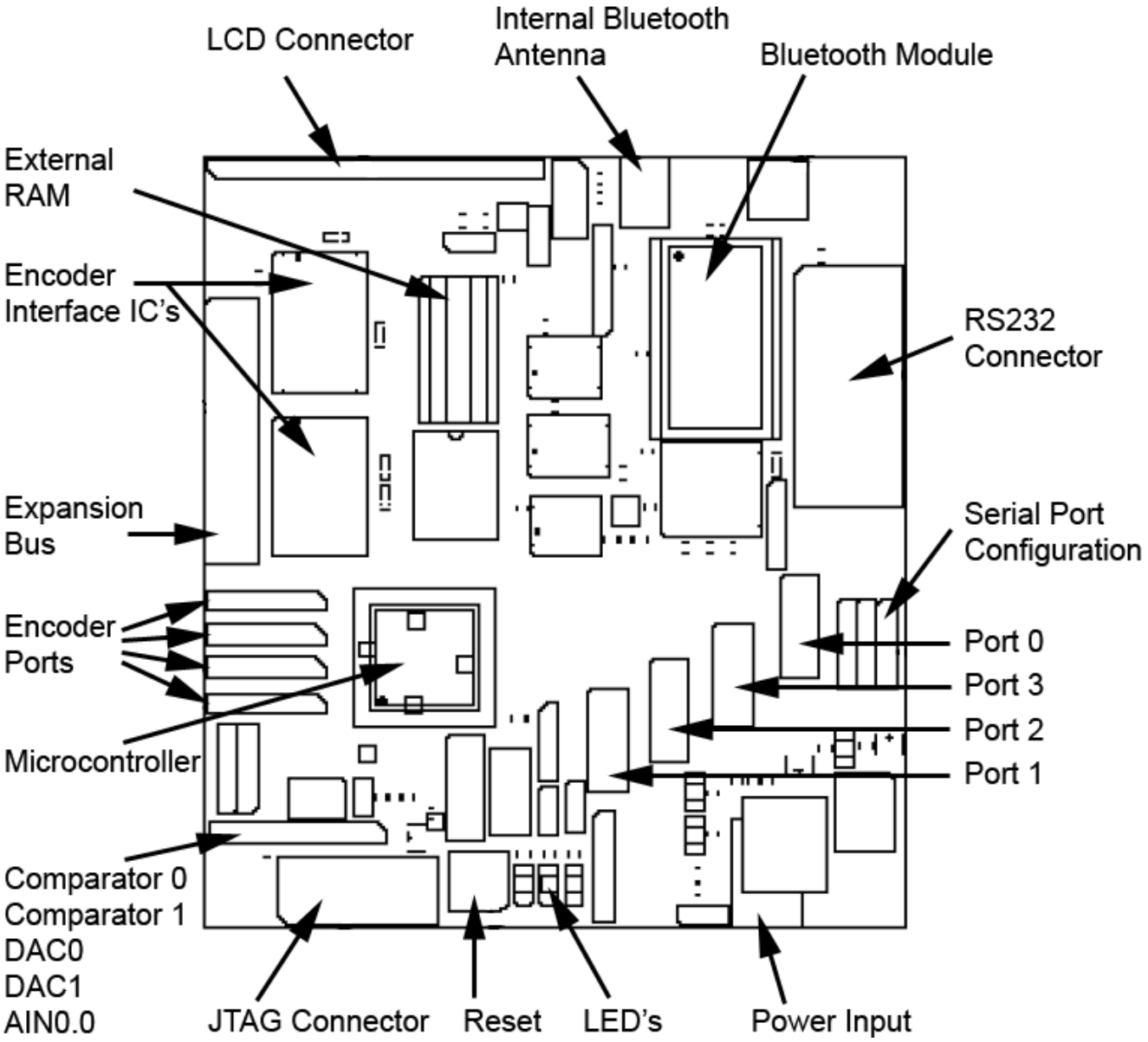
- An **embedded system** is a processor based system designed to perform one or a few dedicated functions often with real-time computing constraints.



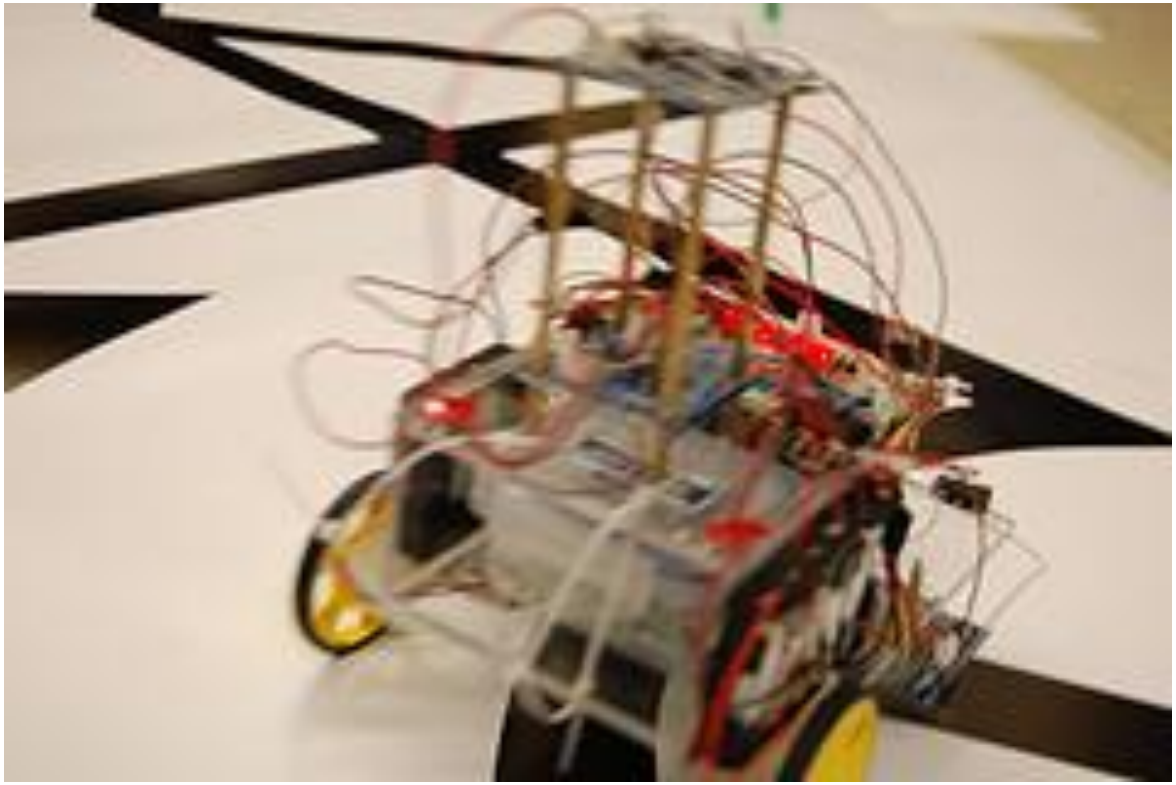
ADSL modem router

1. Telephone decoupling electronics (for ADSL). 2. Multicolour LED (displaying network status). 3. Single colour LED (displaying USB status). 4. Main processor, a TNETD7300GDU, a member of Texas Instruments' AR7 product line. 5. JTAG (Joint Test Action Group) test and programming port. 6. RAM, a single ESMT M12L64164A 8 MB chip. 7. Flash memory, obscured by sticker. 8. Power supply regulator. 9. Main power supply fuse. 10. Power connector. 11. Reset button. 12. Quartz crystal. 13. Ethernet port. 14. Ethernet transformer, Delta LF8505. 15. KS8721B ethernet PHY transmitter receiver. 16. USB port. 17. Telephone (RJ11) port. 18. Telephone connector fuses.

8051 based MRCP(Mobile Robot Control Platform) processor board (Courtesy Quanser, 2005)



MRCP Components (Courtesy Quanser, 2005)



Undergraduate student’s project

Undergraduate student’s project

Undergraduate student’s project

Undergraduate student’s project

- Numbering in computing systems
- Digital primer
- Number base conversion and arithmetic operation

- Numbering

  - Human beings use base 10 (decimal) arithmetic
    - There are 10 distinct symbols, 0, 1, 2, …,9

  - Computers use base 2 (binary) system
    - There are only 0 and 1
    - These two binary digits are commonly referred to as bits

- Numbering
  - The weight of each bit in a binary number

MSB(most significant bit) ← **LSB**(least significant bit)

Binary	1	1	1	1
Decimal	8	4	2	1

Ex. Convert 11001_2 to decimal

Weight:	2^4	2^3	2^2	2^1	2^0
Digits:	1	1	0	0	1
Sum:	16 +	8 +	0 +	0 +	$1 = 25_{10}$

- Numbering
  - Addition of 1 bit binary numbers

Augend		Addend	Carry	Sum
0	+	0	0	0
0	+	1	0	1
1	+	0	0	1
1	+	1	1	0

- Numbering
  - Subtraction of 1 bit binary numbers

Minuend		Subtrahend	Borrow	Difference
0	-	0	0	0
0	-	1	1	1
1	-	0	0	1
1	-	1	0	0

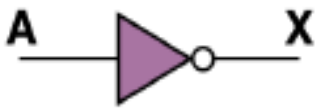
- Numbering
  - The unit of data size
    - Bit : a binary digit that can have the value 0 or 1
    - Byte : 8 bits
    - Nibble : half of a bye, or 4 bits
    - Word : two bytes, or 16 bits
  - The terms used to describe amounts of memory
    - Kilobyte (K): 2^{10} bytes
    - Megabyte (M) : 2^{20} bytes, over 1 million
    - Gigabyte (G) : 2^{30} bytes, over 1 billion
    - Terabyte (T) : 2^{40} bytes, over 1 trillion

- Digital primer
  - Inverter

Boolean Expression

$X = A'$

Logic Diagram Symbol



Truth Table

A	X
0	1
1	0

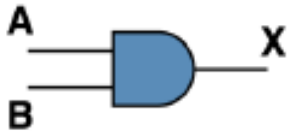
Computer Science Illuminated, Dale and Lewis

- Digital primer
  - AND gate

Boolean Expression

$X = A \cdot B$

Logic Diagram Symbol



Truth Table

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

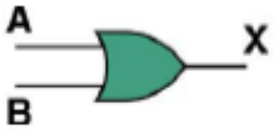
Computer Science Illuminated, Dale and Lewis

- Digital primer
  - OR gate

Boolean Expression

$X = A + B$

Logic Diagram Symbol



Truth Table

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

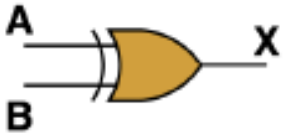
Computer Science Illuminated, Dale and Lewis

- Digital primer
  - XOR gate

Boolean Expression

$X = A \oplus B$

Logic Diagram Symbol



Truth Table

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

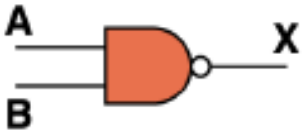
Computer Science Illuminated, Dale and Lewis

- Digital primer
  - NAND gate

Boolean Expression

$X = (A \cdot B)'$

Logic Diagram Symbol



Truth Table

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

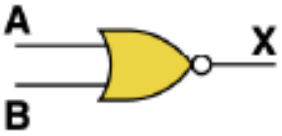
Computer Science Illuminated, Dale and Lewis

- Digital primer
  - NOR gate

Boolean Expression

$X = (A + B)'$

Logic Diagram Symbol

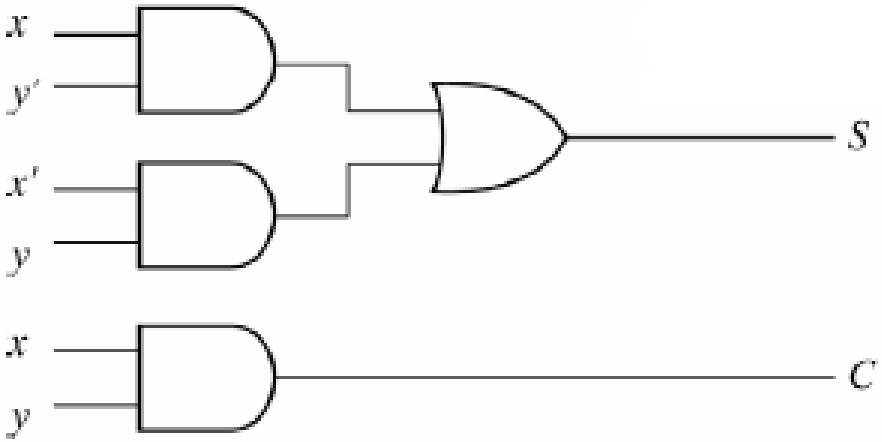


Truth Table

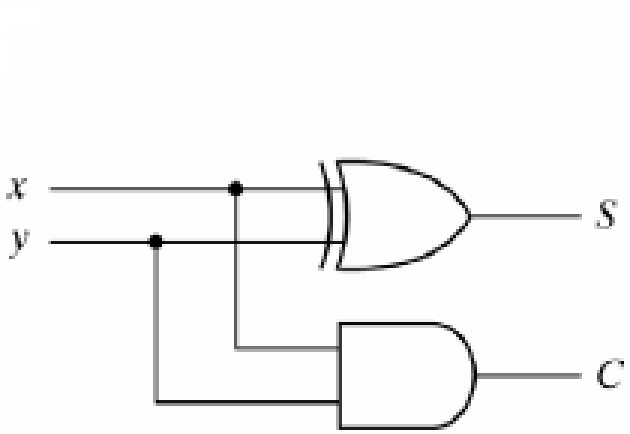
A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

Computer Science Illuminated, Dale and Lewis

- Digital primer
  - Half adder

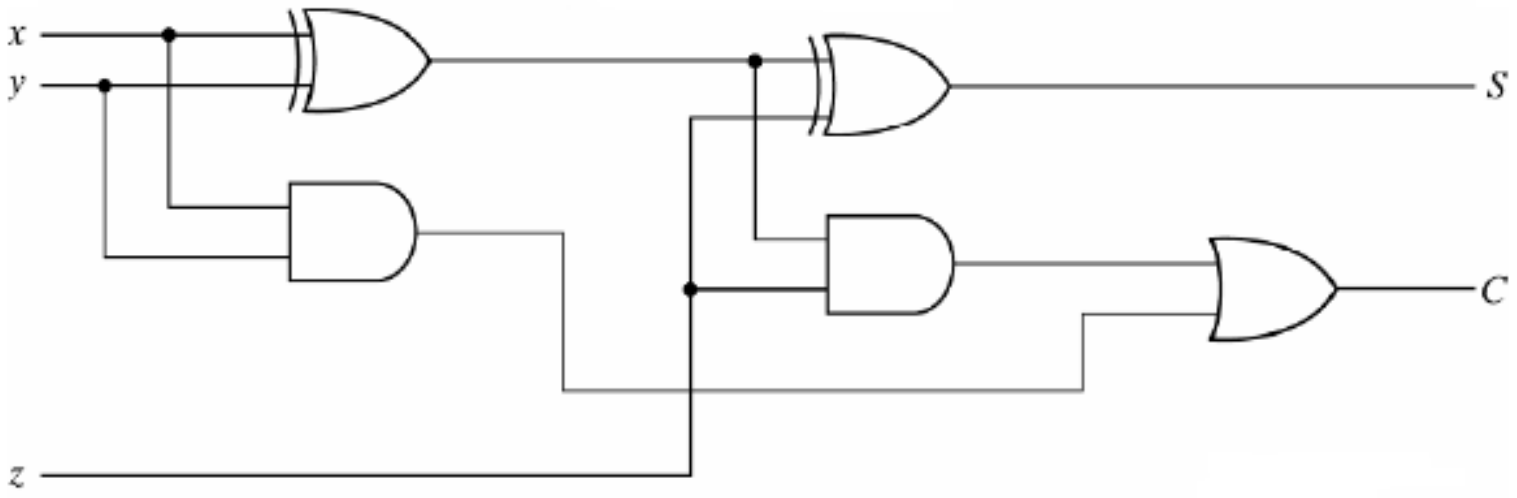


(a) $S = xy' + x'y$
$C = xy$

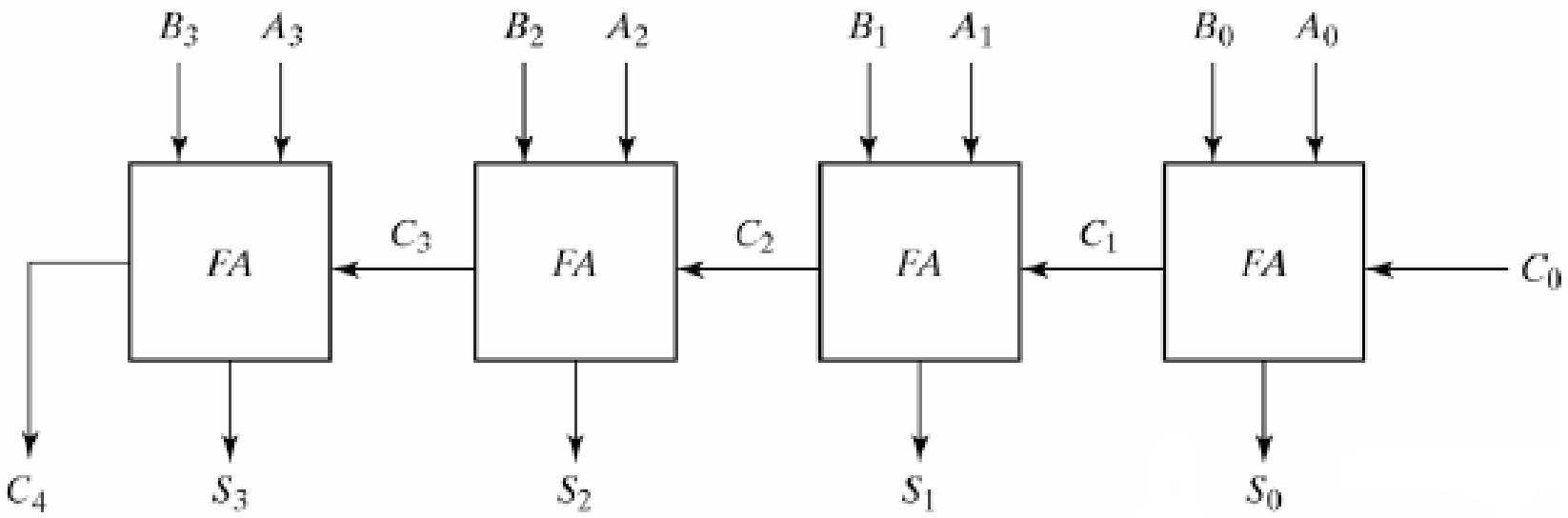


(b) $S = x \oplus y$
$C = xy$

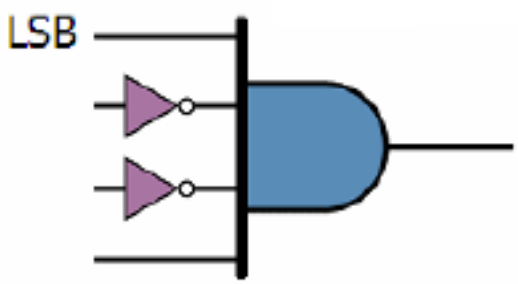
- Digital primer
  - Full adder



- Digital primer
  - 4 bit adder

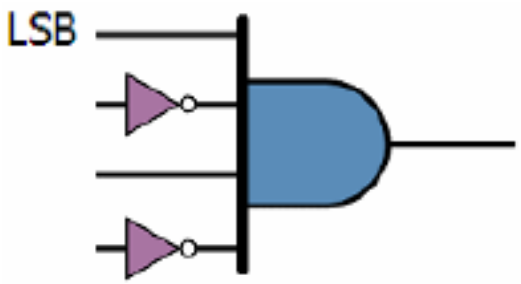


- Digital primer
  - Address decoder



Address decoder for 9 (1001_2)

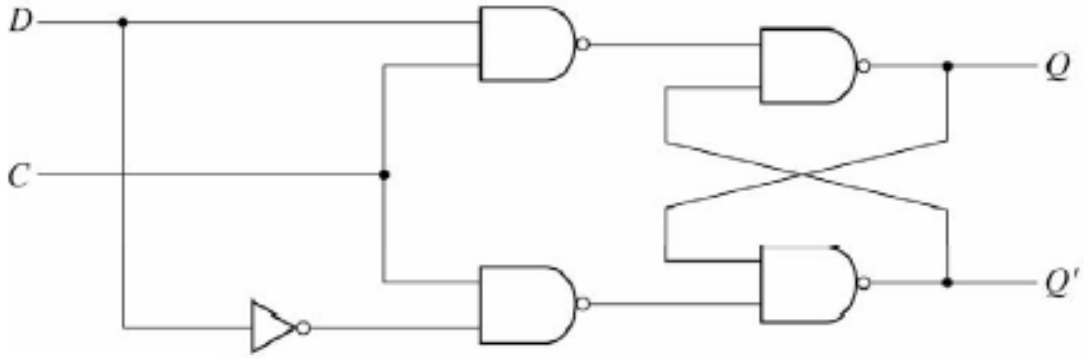
The output will be 1 if and only if the input is 1001_2



Address decoder for 5 (0101_2)

The output will be 1 if and only if the input is 0101_2

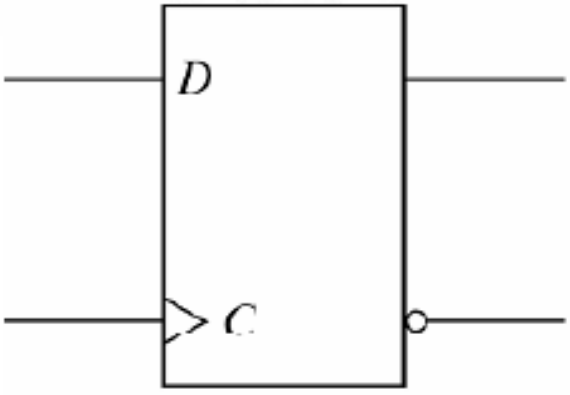
- Flip-flops: Frequently used to store data



(a) Logic diagram

C	D	Next state of Q
0	X	No change
1	0	Q = 0; Reset state
1	1	Q = 1; Set state

(b) Function table



- Number base conversion and arithmetic operation
  - Representation of numbers
  - Number Base Conversion
  - Arithmetic Operations on Unsigned Binary Integer Numbers
  - Two's Complement Numbers