LAB - 03

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Outline

- Video preview for 布林代數+全及項
- Mid Exam
- Lab I -- Comparator
- Lab II -- Constant Multiplier
- Lab III(practice) -- Constant Comparator

Mid Exam

- 考試日期：
  - 10/08(四) 09:00-12:00
- 考試方式：以個人為單位
- 考試時間：50 min

Three representations for a circuit

1. Boolean Algebra

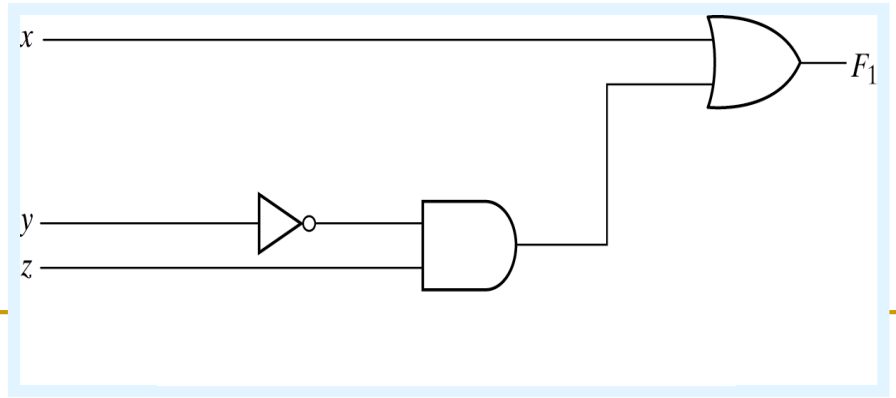
$F_1 = x + y'z$

2. Truth Table 真值表

n input variables ➔ 2^n combinations

Inputs					
x	*y*	*z*	*y'*	*y'z*	F_1
0	0	0	1	0	0
0	0	1	1	1	1
0	1	0	0	0	0
0	1	1	0	0	0
1	0	0	1	0	1
1	0	1	1	1	1
1	1	0	0	0	1
1	1	1	0	0	1

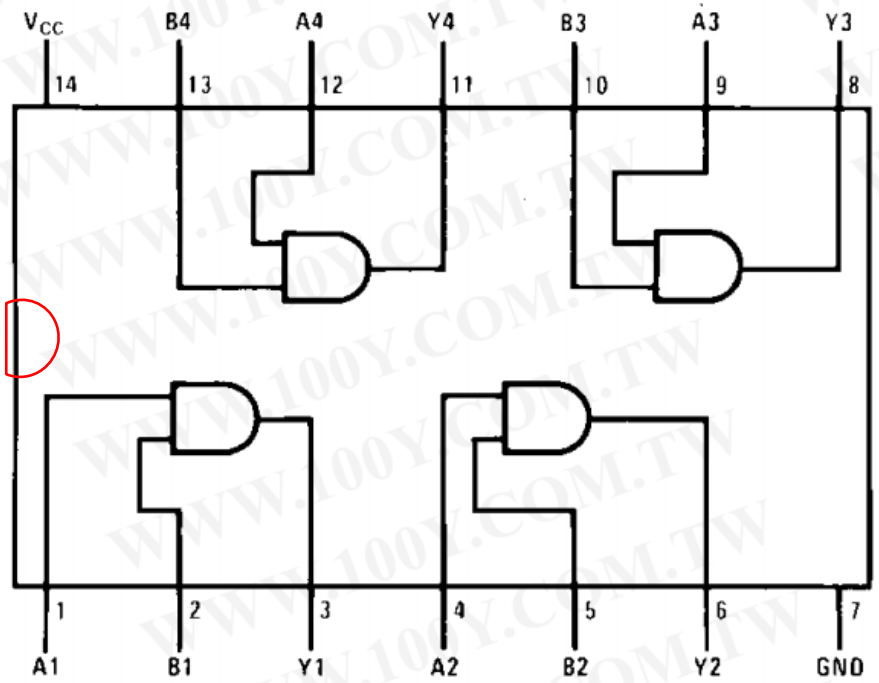
3. Circuit Diagram



74LS08

AND gate

Connection Diagram



Function Table

$Y = AB$

Inputs		Output
A	B	Y
L	L	L
L	H	L
H	L	L
H	H	H

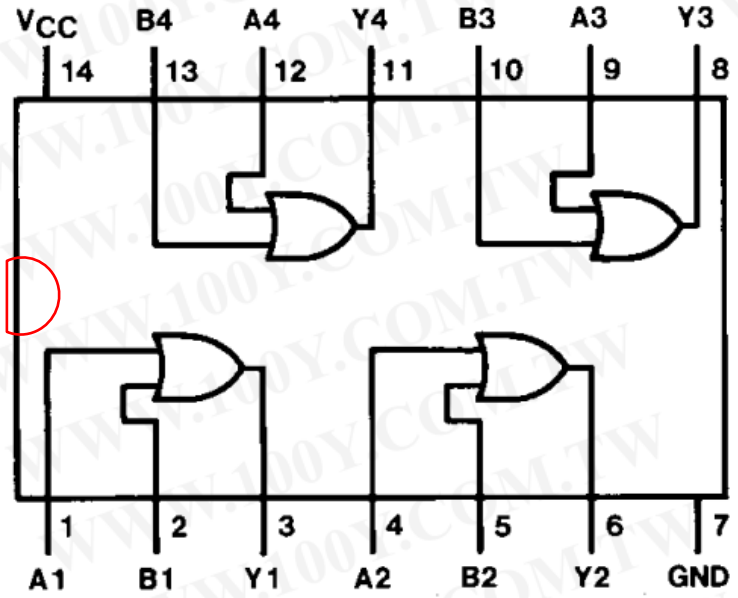
H = HIGH Logic Level
L = LOW Logic Level

Boolean Algebra $F=xy$

74LS32

OR gate

Connection Diagram



Function Table

$Y = A + B$

Inputs		Output
A	B	Y
L	L	L
L	H	H
H	L	H
H	H	H

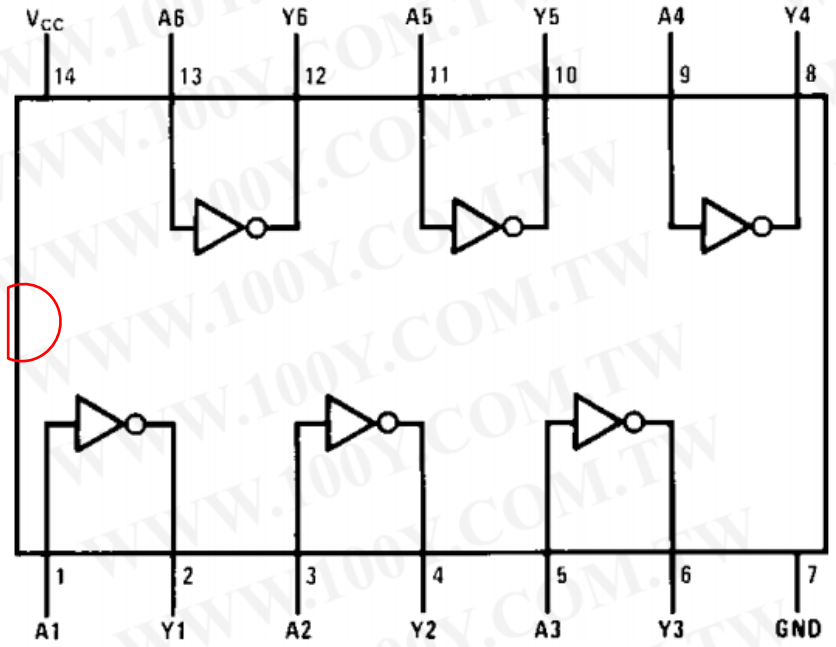
H = HIGH Logic Level
L = LOW Logic Level

Boolean Algebra $F=x+y$

74LS04

NOT gate

Connection Diagram



Function Table

$$Y = \overline{A}$$

Input	Output
A	Y
L	H
H	L

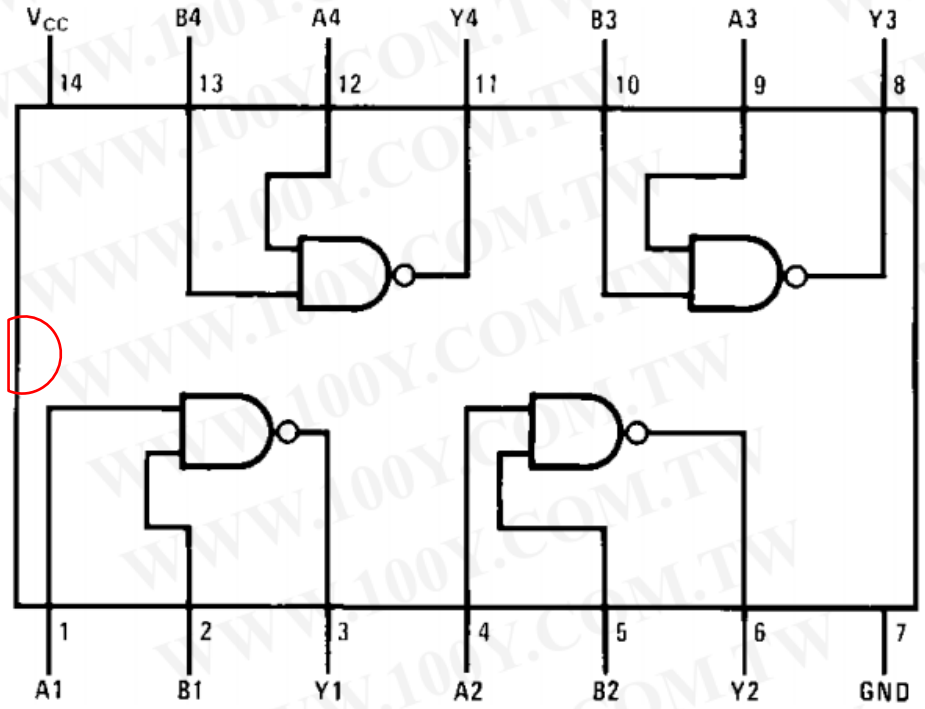
H = HIGH Logic Level
L = LOW Logic Level

Boolean Algebra $F=x'$

74LS00

NAND gate Not - AND

Connection Diagram



Function Table

$$Y = \overline{AB}$$

Inputs		Output
A	B	Y
L	L	H
L	H	H
H	L	H
H	H	L

H = HIGH Logic Level

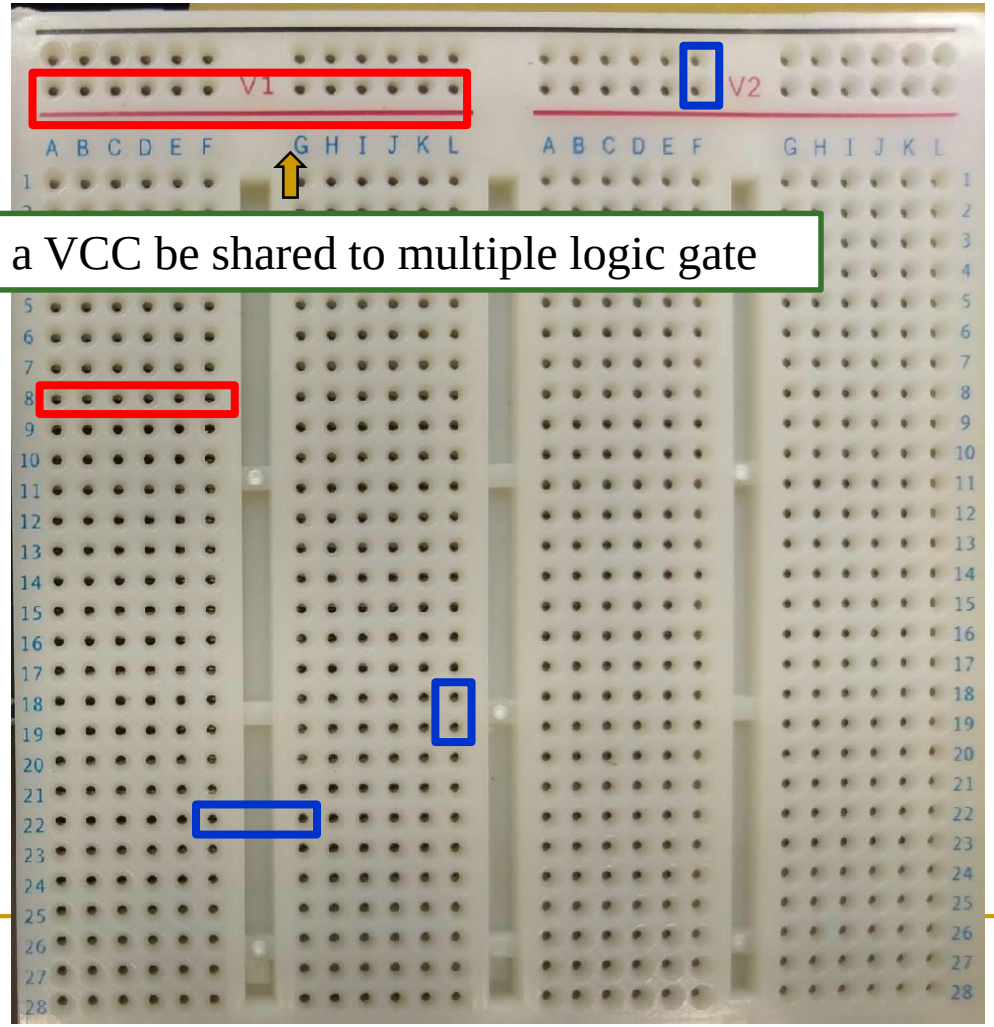
L = LOW Logic Level

Boolean Algebra *F=(xy)'*

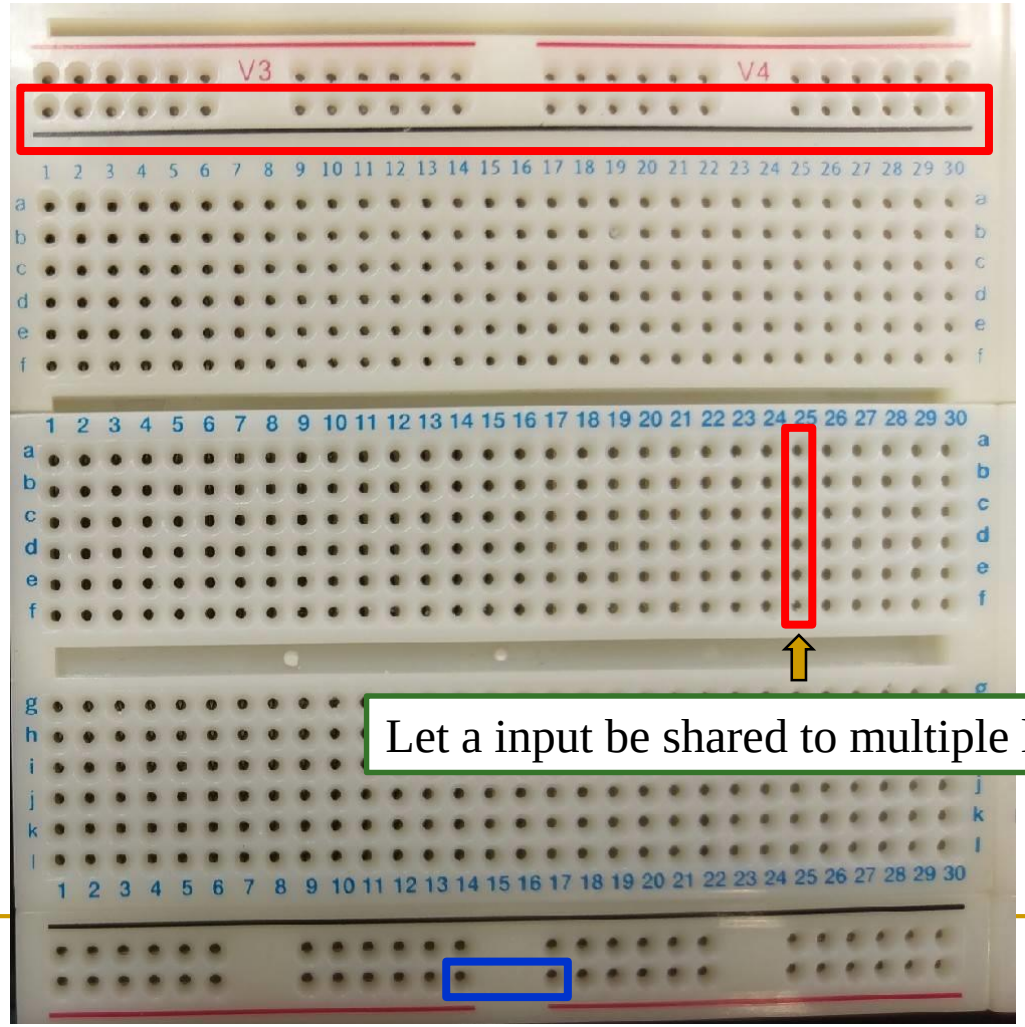
Top View of the Solderless Breadboard

: connected

: disconected



Let a VCC be shared to multiple logic gate



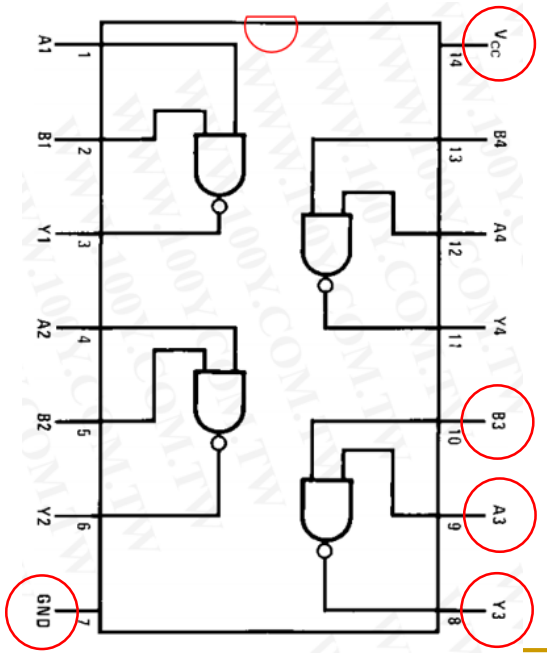
Let a input be shared to multiple logic gate

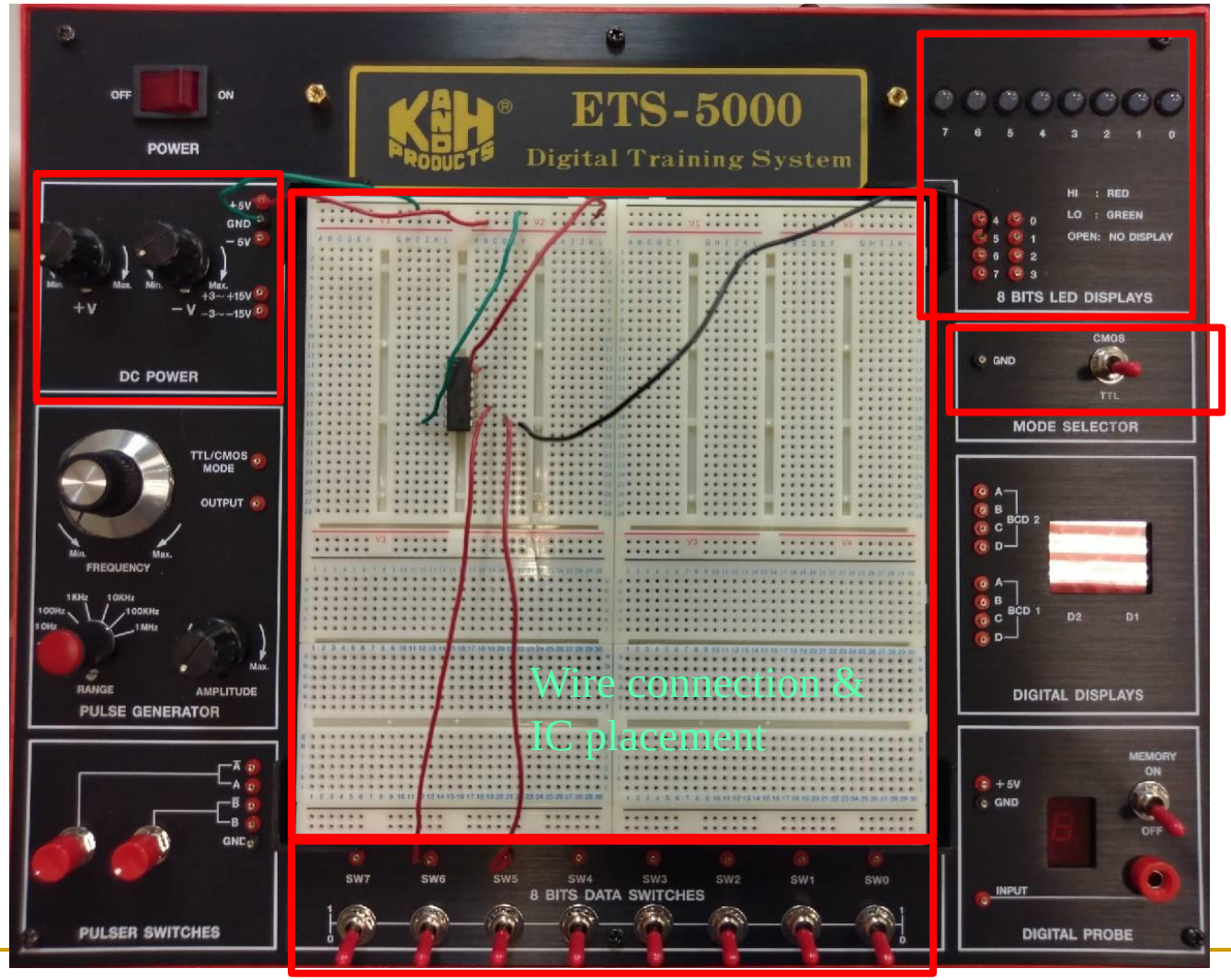
Example: Connection with 74LS00 Chip

- **Board**

power supply

Chip(NAND)





output

TTL mode

input

Lab I – Comparator (1/2)

- **There are two inputs denoted as A and B. Both A and B are 1-bit value. A comparator is designed to determine whether A is equal to B or not. The output results are represented with E .**
- **The function and truth table of the comparator is described as follows.**

$$E = \begin{cases} 1 & ,if\ A\ is\ equal\ to\ B \\ 0 & ,else \end{cases}$$

A	B	E
0	0	1
0	1	0
1	0	0
1	1	1

用全及項的概念去推導布林表示式

Lab I – Comparator (2/2)

Please

(a) write Boolean algebra of the comparator.

(b) implement the circuit on the breadboard.

Components needed for LAB I

Names	Amount
Solerless Breadboard	×1
74LS04	×1
74LS08	×1
74LS32	×1

Notice for LAB I

- **Input**

- **Output**

Lab II -- Constant Multiplier (1/4)

- There is a 2-bit input X (represented as X1 (MSB) and X0). A constant multiplier is designed to multiply the input by 3. Finally, show the result with decimal format (0, 1, 2, …..,9) on Digital Display in the breadboard.

  Hint-1:

  The output digital number is 0, 3, 6 or 9, respectively, for four different inputs (0, 1, 2, 3).

Lab II -- Constant Multiplier (3/4)

Hint-3:

Write Boolean Algebra. (D = ? C = ? B = ? A = ?) 用全及項的概念去推導布林表示式

X1	X0	Decimal	D	C	B	A	Decimal
0	0	0	0	0	0	0	0
0	1	1	0	0	1	1	3
1	0	2	0	1	1	0	6
1	1	3	1	0	0	1	9

Lab II -- Constant Multiplier(4/4)

Please

(a) draw the circuit diagram of the constant multiplier.

(b) implement the circuit on the breadboard, and show the result with decimal format (0, 1, 2, …..,9) on Digital Display in the breadboard.

Components needed for LAB II

Names	Amount
Solerless Breadboard	×1
74LS04	×1
74LS08	×1
74LS32	×1

Lab III – Constant Comparator(practice) (1/2)

- There are a 3-bit input X (represented as X2, X1 and X0) and two 1-bit outputs A and B. The comparator is designed to let output A be 1 if X>3 and output B be 1 if X>4.

MSB LSB

- The function of the comparator is described as follows.

$$A = \begin{cases} 1 & ,if\ X\ is\ greater\ than\ 3 \\ 0 & ,else \end{cases}$$

$$B = \begin{cases} 1 & ,if\ X\ is\ greater\ than\ 4 \\ 0 & ,else \end{cases}$$

Lab III– Constant Comparator (practice) (2/2)

Please

(a) draw the truth table of the comparator where three input bits are X2, X1 and X0, and two output bits are A and B, respectively.

(b) implement the circuit on the breadboard.

Components needed for LAB II

Names	Amount
Solerless Breadboard	×1
74LS04	×1
74LS08	×1
74LS32	×1

Notice for LAB III

- **Input**

- **Output**