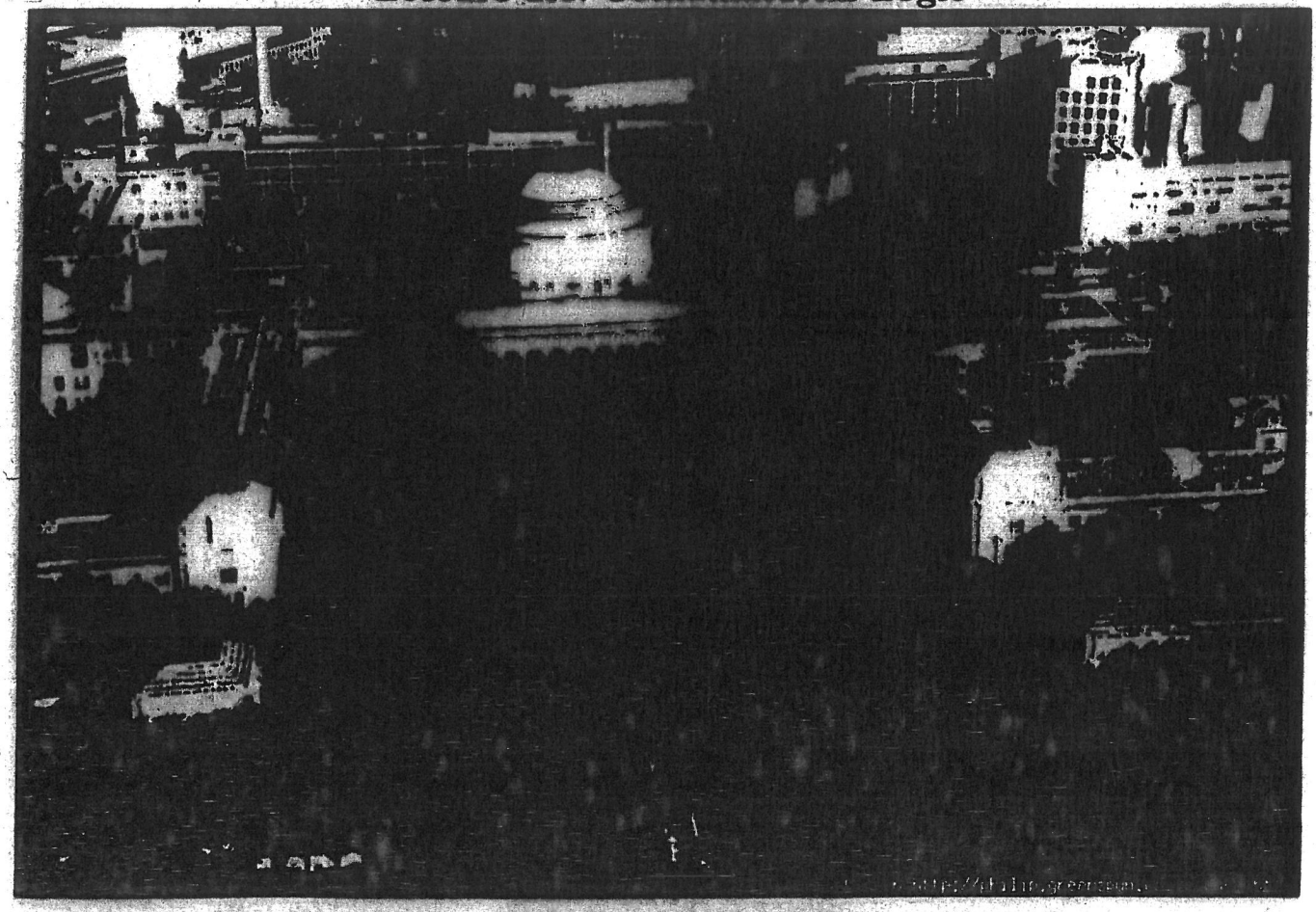
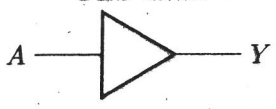
Build a Digital Clock from the 1980's

Lecture 2A: Combinatorial Logic



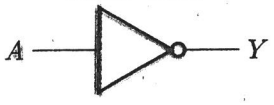
Original photo courtesy of Philip Greenspun (http://philip.greenspun.com/)
Edited using the GNU Image Manipulation Program (https://www.gimp.org/)

YES Gate



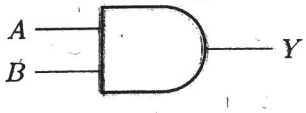
A	Y
0	0
1	1

NOT Gate



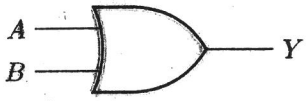
A	Y
0	1
1	0

AND Gate



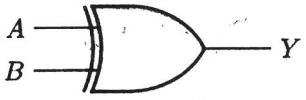
A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

OR Gate



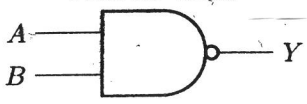
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

XOR Gate



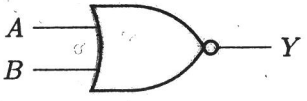
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

NAND Gate



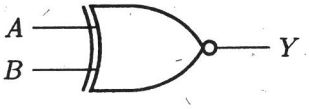
A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

NOR Gate



A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

XNOR Gate



A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

Numerical Representations

Decimal:

6873

$$(6 \times 10^3) + (8 \times 10^2) + (7 \times 10^1) + (3 \times 10^0)$$

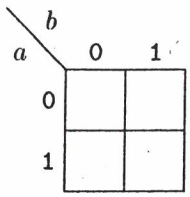
Sexagesimal:

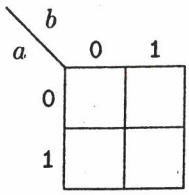
$$(1 \times 60^2) + (54 \times 60^1) + (33 \times 60^0)$$
$$(1 \times 3600) + (54 \times 60) + (33 \times 1)$$
$$3600 + 3240 + 33 = 6873$$

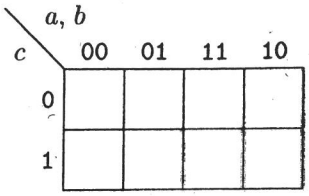
Binary:

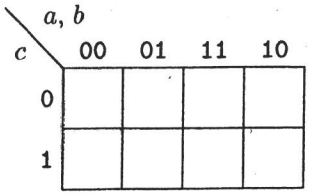
1101011011001

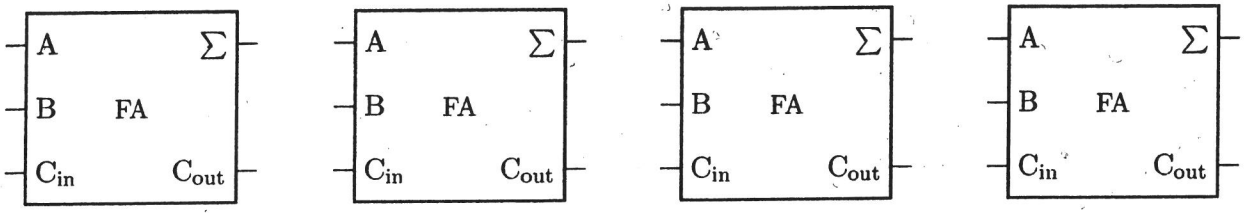
$$(1 \times 2^{12}) + (1 \times 2^{11}) + (1 \times 2^9) + (1 \times 2^7) + (1 \times 2^6) + (1 \times 2^4) + (1 \times 2^3) + (1 \times 2^0)$$
$$4096 + 2048 + 512 + 128 + 64 + 16 + 8 + 1$$

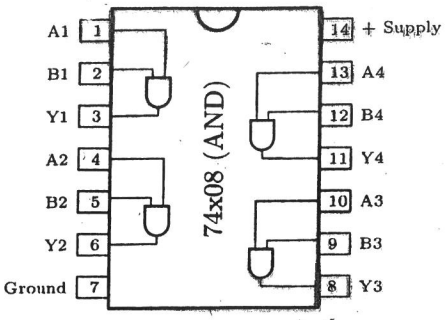

b
a
0
1
0
1

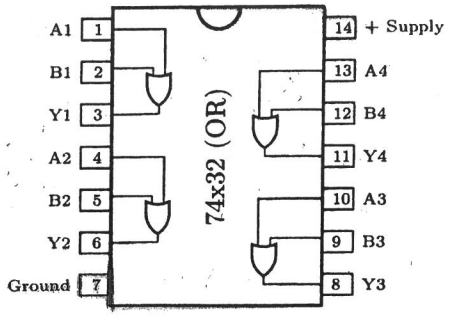

b
a
0
1
0
1

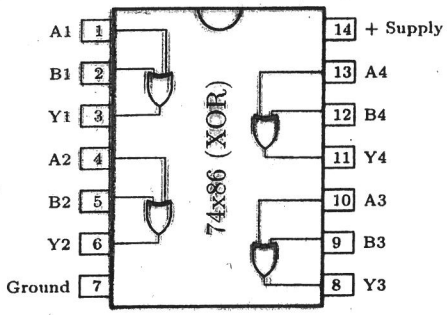

a, b
c
00
01
11
10
0
1


a, b
c
00
01
11
10
0
1


A
Σ
B
FA
Cin
Cout
A
Σ
B
FA
Cin
Cout
A
Σ
B
FA
Cin
Cout
A
Σ
B
FA
Cin
Cout


A1 1
B1 2
Y1 3
A2 4
B2 5
Y2 6
Ground 7
14 + Supply
13 A4
12 B4
11 Y4
10 A3
9 B3
8 Y3
74x08 (AND)


A1 1
B1 2
Y1 3
A2 4
B2 5
Y2 6
Ground 7
14 + Supply
13 A4
12 B4
11 Y4
10 A3
9 B3
8 Y3
74x32 (OR)


A1 1
B1 2
Y1 3
A2 4
B2 5
Y2 6
Ground 7
14 + Supply
13 A4
12 B4
11 Y4
10 A3
9 B3
8 Y3
74x86 (XOR)

0000

0001

0010

0011

0100

0101

0110

0111

1000

1001

1010

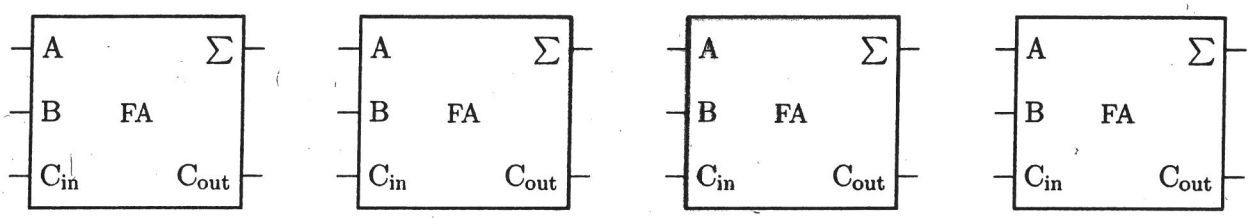
1011

1100

1101

1110

1111


A
Σ
B
FA
Cin
Cout
A
Σ
B
FA
Cin
Cout
A
Σ
B
FA
Cin
Cout
A
Σ
B
FA
Cin
Cout