Lecture 11

Homework 3 - Seven Segment Display

The Really Hard way...

```
c = ( !I & !J & !K & !L ) |
    ( !I & !J & !K & L ) |
       ...
```

The Mostly Hard Way... Reduction using a K-Map

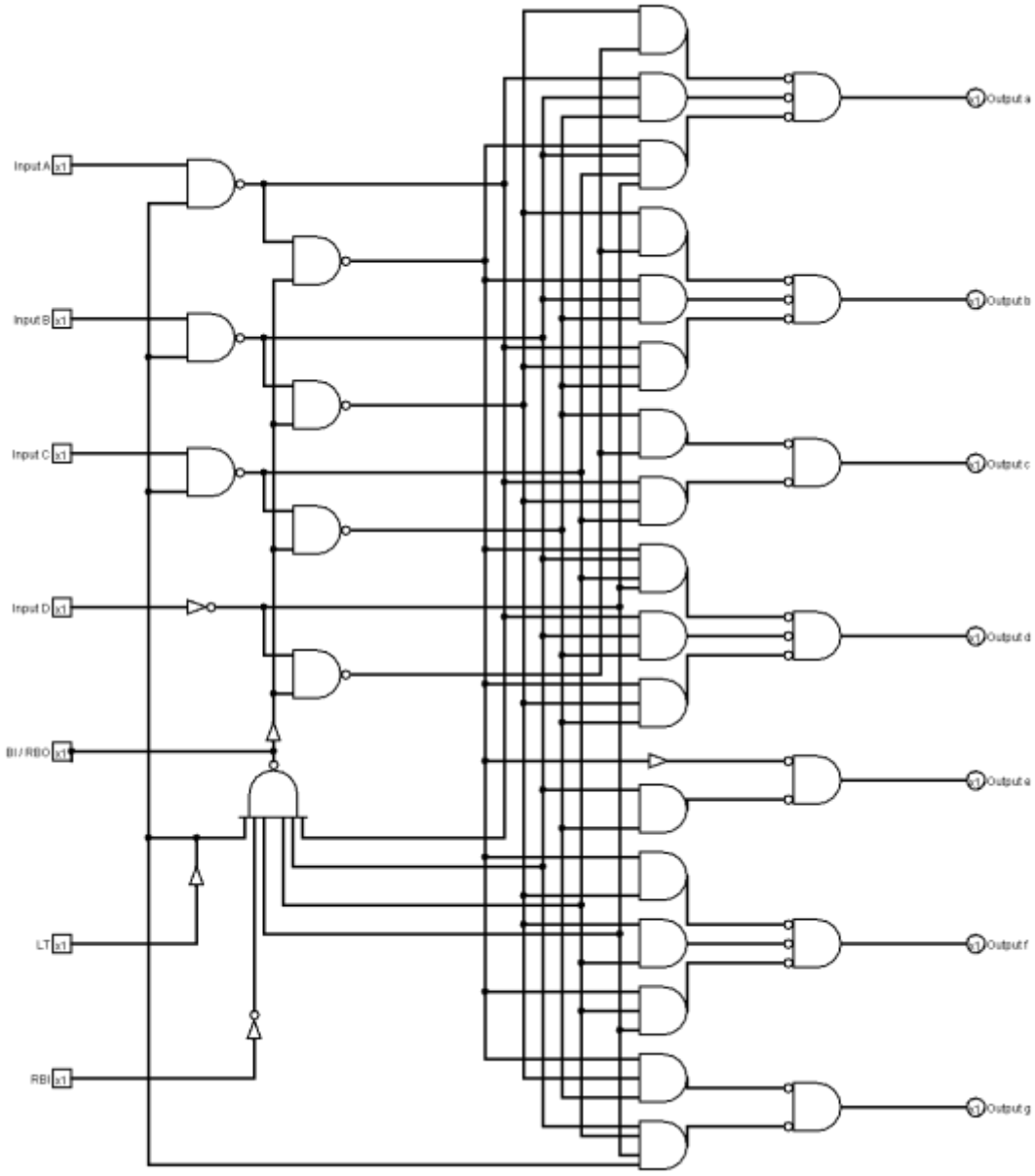
for `c`:

K L Across top

	0 0	0 1	1 0	1 1
I J 0 0	1	1	0	1
0 1	1	1	1	1
1 0	1	1	0	1
1 1	0	0	0	0

Decimal Digit	Hex	I	J	K	L		a	b	c	d	e	f	g	Display Pattern
0	0x0	0	0	0	0		1	1	1	1	1	1	0	
1	0x1	0	0	0	1		0	1	1	0	0	0	0	
2	0x2	0	0	1	0		1	1	0	1	1	0	1	
3	0x3	0	0	1	1		1	1	1	1	0	0	1	
4	0x4	0	1	0	0		0	1	1	0	0	1	1	
5	0x5	0	1	0	1		1	0	1	1	0	1	1	
6	0x6	0	1	1	0		1	0	1	1	1	1	1	
7	0x7	0	1	1	1		1	1	1	0	0	0	0	
8	0x8	1	0	0	0		1	1	1	1	1	1	1	
9	0x9	1	0	0	1		1	1	1	1	0	1	1	
10	0xA	1	0	1	0		1	0	0	1	1	1	1	
11	0xB	1	0	1	1		1	0	0	1	1	1	1	
12	0xC	1	1	0	0		1	0	0	1	1	1	1	
13	0xD	1	1	0	1		1	0	0	1	1	1	1	
14	0xE	1	1	1	0		1	0	0	1	1	1	1	
15	0xF	1	1	1	1		1	0	0	1	1	1	1	

Final:



The Easy way...

74Ls138 a 3 address, 8 output ROM - pair 2 of them.

Or ATMEL, AT28C64B and not use all of it.
http://ww1.microchip.com/downloads/en/DeviceDoc/doc0270.pdf

More on Instructions

xxx is the 12 bits of 'hand'.

Op	Hex Code	Implemented by
JnS	0x0xxx	mdr = pc
		mar = hand
		mem[mar] = mdr
		ac = hand
		ac = ac + 1
		pc = ac
Load	0x1xxx	mar = hand
		mdr = mem[mar]
		ac = mdr
Store	0x2xxx	mar = hand
		mdr = ac
		mem[mar] = mdr
Add	0x3xxx	mar = hand
		mdr = mem[mar]
		ac = ac + mdr
Subt	0x4xxx	mar = hand
		mdr = mem[mar]
		ac = ac - mdr
Input	0x5000	Input Reg ⟸ ⟸
Output	0x6000	Output Reg ⟹
Halt	0x7000	Do Nothing

Op	Hex Code	Implemented by
Skipcond	0x8y00	see below
Lt0	y == 0x0	if ac >= 0, pc += 1
Eq0	y == 0x4	if ac == 0, pc += 1
Gt0	y == 0x8	if ac <= 0, pc += 1
Jump	0x9xxx	pc = hand
Clear	0xA000	ac = 0
AddI	0xBxxx	mar = hand
		mdr = mem[mar]
		mar = mdr
		mdr = mem[mar]
		ac = ac + mdr
JumpI	0xCxxx	mar = hand
		mdr = mem[mar]
		pc = mdr
LoadI	0xDxxx	mar = hand
		mdr = mem[mar]
		mar = mdr
		mdr = mem[mar]
		ac = mdr
StoreI	0xExxx	mar = hand
		mdr = mem[mar]
		mar = mdr
		mdr = ac
		mem[mar] = mdr

References:

The 7 seg is from https://quickgrid.wordpress.com/2015/03/22/7-segment-decoder-implementation-truth-table-logisim-diagram/