

Midterm Exam Review

Data representation

- For parts a-c: Fill in the missing values of this chart. All binary and hexadecimal values are given in 8-bit two's complement form. Each row represents the same number in decimal, binary, and hexadecimal.

	Decimal	Binary	Hexadecimal
a.	-37		
b.		0001 1110	
c.			0xAB

Data representation: Answer

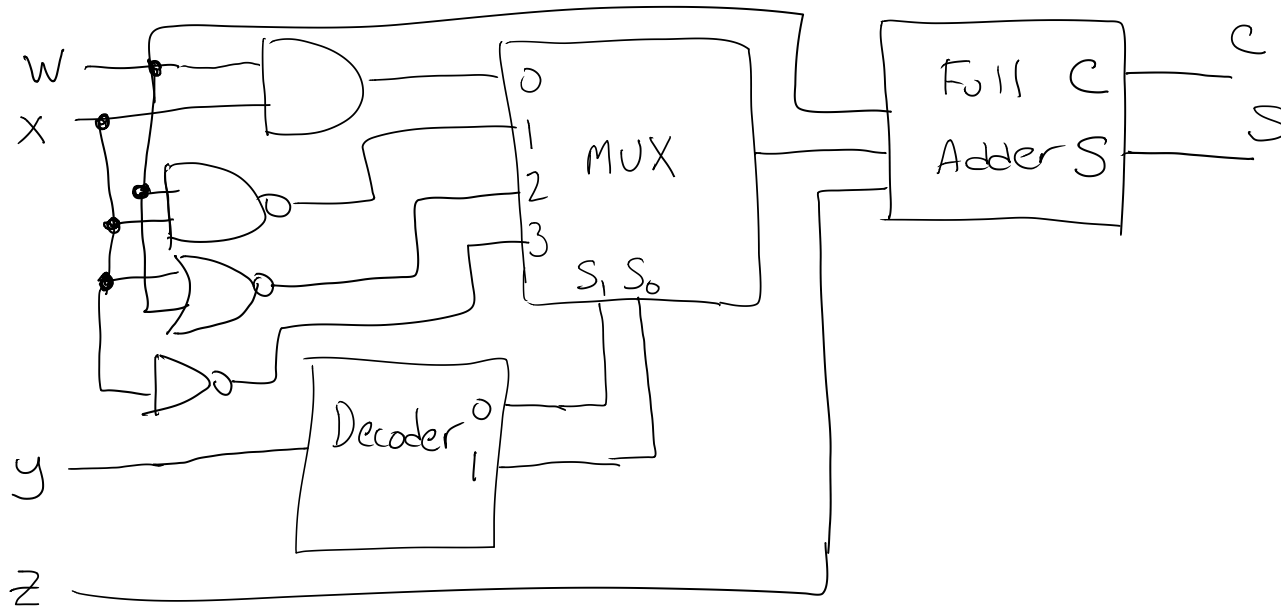
	Decimal	Binary	Hexadecimal
a.	-37	11011011	0xDB
b.	30	0001 1110	0x1E
c.	-85	10101011	0xAB

Floating Point Representation

- What number does the 32-bit IEEE floating point number 0x44044000 represent?
 - 529
 - (sign: 0, exponent: 9, fraction: 000010001)

Truth Table

- Complete the truth table for the contrived circuit below. The circuit has four inputs (w, x, y, z) and two outputs (C, S).



Truth Table: Answer

w	x	y	z	MUX	C	S
0	0	0	0	1	0	1
0	0	0	1	1	1	0
0	0	1	0	1	0	1
0	0	1	1	1	1	0
0	1	0	0	0	0	0
0	1	0	1	0	0	1
0	1	1	0	1	0	1
0	1	1	1	1	1	0
1	0	0	0	0	0	1
1	0	0	1	0	1	0
1	0	1	0	1	1	0
1	0	1	1	1	1	1
1	1	0	0	0	0	1
1	1	0	1	0	1	0
1	1	1	0	0	0	1
1	1	1	1	0	1	0

Short Answer Questions

- Solve for n : $2^n = 512\text{M}$
 - 29
- Why do memory systems use a shared bus?
 - A shared bus is used because it is too costly and consumes too much space if each memory cell had their own dedicated line.
- How do circuit designers prevent the shared buses (in memory) from short-circuiting?
 - Short-circuiting is prevented by using tri-state buffers such that at most one memory cell is writing to the shared bus at any given time.

Floating Point Conversion

- Convert 55.25 to single precision IEEE floating point format
- Convert 55 to binary: 110111
- Convert 0.25 to binary: 0.01
- Therefore $55.25 = 110111.01$
- Convert 110111.01 to scientific notation:
 - $1.1011101 * 2^5$
- Convert exponent to excess-127: 10000100
- Sign is positive so sign bit = 0
- Putting it all together:
 - 0 10000100 1011101 0000 0000 0000 0000
 - 0x425d0000

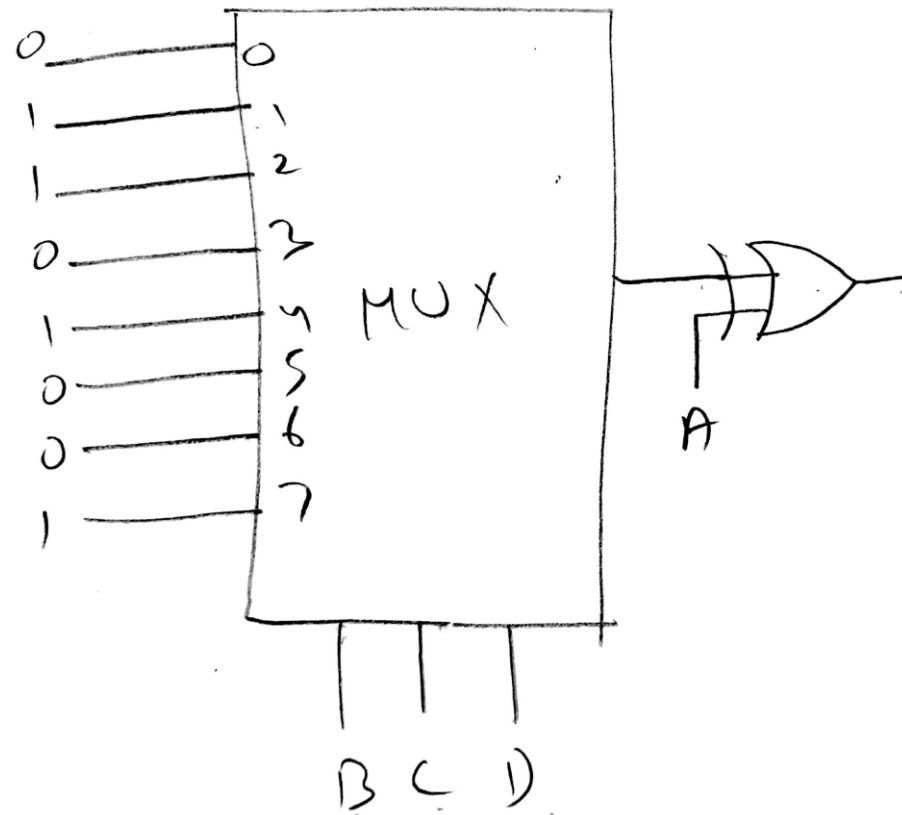
Multiplexers

- In class, we used an 8 input multiplexer to implement a three-variable majority function. In this question, we are going to use the same multiplexer for implementing an odd parity function, i.e., the output is 1 if and only if an odd number of inputs are 1. However, for this question, instead of three, you will have four input variables: A, B, C, D.
 - A. Create a truth table for the four variable odd parity function.
 - B. Using the following 8-input multiplexer, implement the Boolean function represented by the truth table in part A.

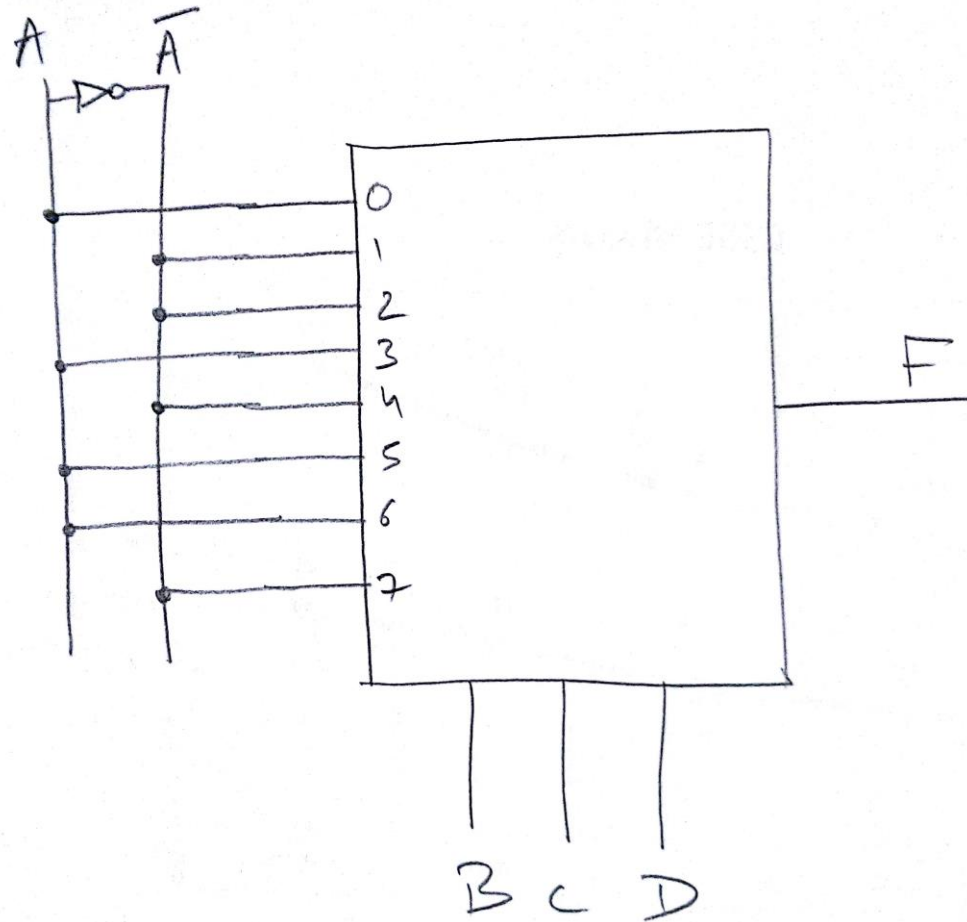
Multiplexers: Truth Table

A	B	C	D	F
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

Multiplexers: Function Implementation



Multiplexers: Alternate Implementation



Memory Addresses

- Given a system with 2^{24} Bytes of total memory and fixed partitions, where each partition is 65,536 Bytes.
 - What is the total number of partitions?
 - $2^{24}/2^{16} = 2^8 = 256$
 - How many bits are needed to address each partition uniquely?
 - 8 bits (because $256 = 2^8$)

ANNA: C++ to ANNA Conversion

- Convert the C++ statement into ANNA: $*p = *p + 1$;
Assume p is a pointer to a 2-byte integer, is properly initialized, and is located at label p .

lli r1 &p

lui r1 &p #r1 = &p

lw r2 r1 0 # r2 = p

lw r3 r2 0 # r3 = *p

addi r3 r3 1 #r3 = *p + 1

sw r3 r2 0 #*p = *p + 1

ANNA: Machine Language Conversion

- Convert the following instructions from ANNA assembly to ANNA machine language. Specify your answer in hexadecimal notation.
- lw r1 r2 -3
 - 0x82bd
- or r5 r4 r2
 - 0x3b10

ANNA: Assembly Language Conversion

- Convert the following ANNA machine code instructions into ANNA assembly
- 0x7ca3
 - lui r6 0xa3 (lui r6 -93 is not correct because the immediate refers to the upper eight bits)
- 0xcfc1
 - addi r7 r7 1

Boolean Functions: Dual

- Which of the following relationships represents the dual of the Boolean property $x + x'y = x + y$? Choose the best answer.
 1. $x'(x + y') = x'y'$
 2. $x(x'y) = xy$
 3. $x * x' + y = xy$
 4. $x'(xy') = x'y'$
 5. $x(x' + y) = xy$
- Ans: $x(x' + y) = xy$

Boolean Functions: Simplification

- Simplify $(A + B)'(C + D + E)' + (A + B)'$
 - Apply the property $x + xy = x$, with $x = (A + B)' = A'B'$ and $y = (C + D + E)' = C'D'E'$
 - Ans: $A'B'$
- Simplify $AB + ABC + ABCD + ABCDE + ABCDEF$
 - Ans: AB
 - Apply absorption theorem repeatedly: $x + xy = x$

Instruction Set Architecture

- Following stack based instructions are available to you:
 - Push M
 - Pop M
 - Add
 - Sub
 - Mul
 - Div
- Using these instructions, write a program to compute:
 - $X = (A + B * C) / (D - E * F)$

Instruction Set Architecture (Solution)

Push A

Push B

Push C

Mul

Add

Push D

Push E

Push F

Mul

Sub

Div

Pop X

Linking

- Following is one possible way of (statically) linking the code: Before scanning the library, the linker builds a list of procedures needed, i.e., the names defined as EXTERN in the modules being linked. Then the linker goes through the library linearly, extracting every procedure that is in the list of names needed. The linker makes only one pass.
 - Does this linking scheme work?
 - If yes, why?
 - If not, why not? How would you fix it?

Linking (Solution)

- It could fail if a procedure pulled out of the library itself needs another procedure in the library and the needed procedure has already been passed.
- Possible fixes:
 1. Make multiple passes over the library
 2. Or, require the library to be sorted so that there are no backward references
 3. Or, put an index at the front of the library telling what every procedure needs, so the complete list is known before the scan starts.

Besides...

- Go through all the material in lecture slides
- Solve all assignment questions
- Do the recommended readings

Thank You!