Pa

3) 10101100

a) even parity → keep it even, you do not need to add another 1

parity bit = 0

odd → if the count is odd, parity bit = 0

even → parity bit = 1

1 is even → parity → parity = 1

Even Parity Rule

odd → parity bit = 1

so if the number of 1's is even, the parity bit is 0

odd parity Rule

count is odd → parity bit = 0

if its even → parity count is 1

b) 10101100

3 2 1 0

10100100 count becomes odd, but even parity expected

→ 3 1's → error detected

MARIA KRSTEVSKI

WXYZ → output 1 iff decimal value >6

a) minterms
What inputs make the output = 1
all 4 bit patterns whose decimal value is 7 - 15

decimal WXYZ (binary)

3 2 1 0
W X Y Z
$2^3 = 8$
$2^2 = 4$
$2^1 = 2$
$2^0 = 1$

	decimal	8 W	4 X	2 Y	1 Z	binary
	7	0	1	1	1	0111
7÷2=3R1	8	1	0	0	0	1000
3÷2=1R1	9	1	0	0	1	1001
1÷2=0R1	10	1	0	1	0	1010
0	11					1011
8÷2=4R0	12					1100
4÷2=2R0	13					1101
2÷2=1R0	14					1110
1÷2=0R1	15					1111

9÷2=4R1
4÷2=2R0
2÷2=1R0
1÷2=0R1

b) Simplify - boolean or kmap

Kmap

WZ \ yx	00	01	11	10
00	0000	0001	0011	0010
01	0100	0101	0111	0110
11	1100	1101	1111	1110
10	1000	1001	1011	1010

→ convert back to decimal, and compare >6

$1 \times 2^2 = 4$

$1 \times 2^1 = 2$

$1 \times 2^0 = 1$

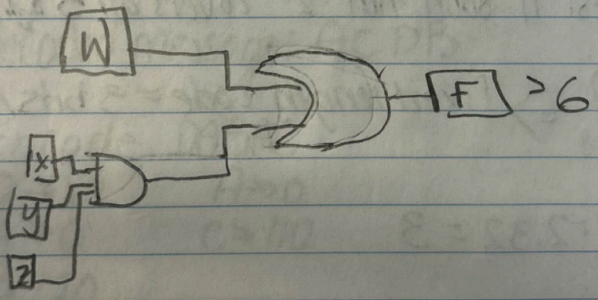
If yes, put 1, if no, put 0

WZ \ yx	00	01	11	10
00	0	0	0	0
01	0	0	1	0
11	1	1	1	1
10	1	1	1	1

Z changes from 1 to 0
W stays as one
y changes

$F = W + XYZ$

Logic circuit



5. Minimum hamming distance
→ 5

a) How many errors?

formula: $d_{min} = 5$

detectable errors: $d_{min} - 1 = 4$
correctable errors: $\frac{d_{min} - 1}{2} = \frac{4}{2} = 2$

6. symbols $\{A, B, C, D, E\}$ $\{0.40, 0.25, 0.20, 0.10, 0.05\}$

fixed length code → 5 symbols
How many different binary strings of length n exist
→ 2^n (each can either be a 0 or 1

find the smallest n such that 2^n covers all 5 symbols

$2^2 = 4 \rightarrow$ NO $\Rightarrow$ fixed length code = 3 bits/symbol
$2^3 = 8 \rightarrow$ yes

$n = \lceil \log_2 5 \rceil = 2.32 = 3$

Average code word length

$L = 3 \rightarrow$ Average length $= \sum p_i \cdot L$

$3 \times (0.40 + 0.25 + 0.20 + 0.10 + 0.05) = 3 \cdot 1 = 3$

→ average length = 3 bits/symbol

8. Huffman table:
A → 0 B → 10 C → 110 D → 1111

decode bit string 01101110

Symbol	code word
A	0
B	10
C	110
D	1111

String: 0 1 1 0 1 1 1 0

index: 0 → matches A
1-3 → 110 → matches C
4-6 → 111 → matches D
7-8 → 10 → matches B

decoded message: ACDB

b) Encode DABAC
D → 1111 A → 0
A → 0 C → 110
B → 10

=> 11101001 10

9. 4 input OR gate using only 2-input OR gates