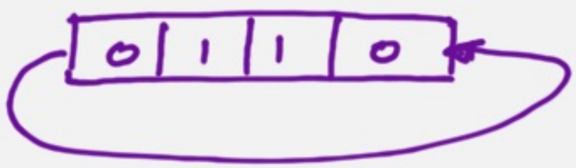
CYCLIC CODES



ROTATE INSTRUCTION
IN μP

IN CYCLIC BLOCK CODES EVERY ROTATE GIVES ANOTHER CODE WORD

WE USE A POLYNOMIAL INSTEAD OF A MATRIX FOR THE CODE GENERATOR

WHAT MAKES BOTH THE MATRIX OPERATIONS AND THE POLYNOMIAL OPERATIONS EASIER THAN "NORMAL" MATHS IS THAT THE MATRIX ELEMENTS AND THE POLYNOMIAL COEFFICIENTS ARE LIMITED TO ONLY "1" OR "0"

AND THE ADDITION (CALLED MODULO-2) IS AN XOR OPERATION

$$0 + 0 = 0$$
$$0 + 1 = 1$$
$$1 + 0 = 1$$
$$1 + 1 = 0$$

CYCLIC CODE

ROTATE LEFT

1010011
0100111
1001110
0011101
0111010
1110100
1101001
1010011

LOOKUP TABLE

MESSAGES	CODEWORDS
0000	0000000
0001	0001011
0010	0010110
⋮	⋮
1111	1111111

16 CODE WORDS

BUT IN ORDER TO HAVE 16 WE MUST USE OTHER CODEWORDS SO FOR THIS CODE TO BE "CYCLIC" EVERY ROTATION OF ANY CODEWORD MUST ALSO BE A CODEWORD WITHIN THE SET

FIRST TO CONVERT BETWEEN A CODEWORD AND IT'S POLYNOMIAL THIS IS HOW IT IS DONE

CODEWORD $\quad 1\ 0\ 1\ 0\ 0\ 1\ 1$

POLYNOMIAL $\quad x^6\ x^5\ x^4\ x^3\ x^2\ x^1\ x^0$

COEFF. IS ZERO THE x^2 DISAPPEARS

POLYNOMIAL $= x^6 + x^4 + x + 1$

$$C(x) = x^6 + x^4 + x + 1$$

$$m(x) = x^3 + x = 1010$$

$$C(x) = x^{n-k} m(x) + P(x)$$

ADD $P(x)$ TO BOTH SIDES

$$C(x) + P(x) = x^{n-k} m(x) + \cancel{P(x)} + \cancel{P(x)}$$

$$x^{n-k} m(x) = \underbrace{C(x)}_{\to\, a(x)\, g(x)} + P(x)$$

DIVIDE EVERYTHING BY GENERATOR POLYNOMIAL

$$\frac{x^{n-k} m(x)}{g(x)} = \frac{a(x)\cancel{g(x)}}{\cancel{g(x)}} + \frac{P(x)}{g(x)}$$

$\rightarrow m = 1010$

$m(x) = x^3 + x$

$$\frac{x^{n-k}\, m(x)}{g(x)} = a(x) + \frac{P(x)}{g(x)}$$

$x^{n-k} = x^3$

$x^3\, m(x) = x^6 + x^4 = 1010000$

$x^{n-k}\, m(x)$

$\rightarrow g(x) = x^3 + x + 1$

$= 1011$

$$\begin{array}{r l}
 & 1001 \quad \leftarrow a(x) \\
1011 & \overline{)1010000} \\
\oplus & 1011 \\
\hline
 & 0001000 \\
 & 1011 \;\oplus \\
\hline
 & 0011 \quad \leftarrow P(x)
\end{array}$$

$a(x) = 1001 = x^3 + 1$

$P(x) = 011 = x + 1$

$g(x) = 1011 = x^3 + x + 1$

$$c(x) = a(x)\,g(x) = (x^3+1)(x^3+x+1)$$

$$= x^6 + x^4 + \cancel{x^3} + \cancel{x^3} + x + 1$$

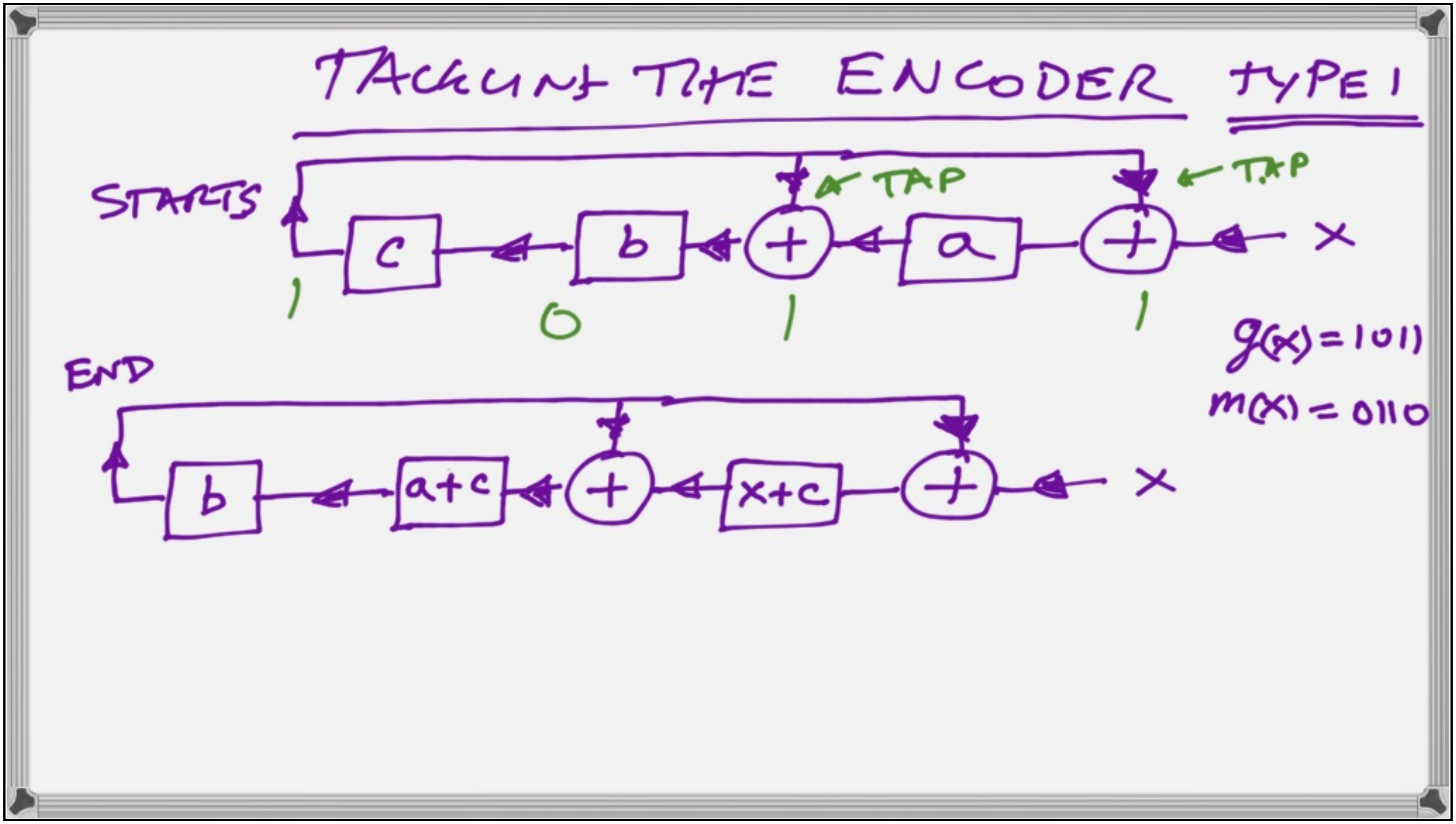
$$= x^6 + x^4 + x + 1$$

$$= 1010011$$

$$C(x) = a(x)\,g(x)$$

$$\frac{C(x)}{g(x)} = a(x) + 0 \text{ REMAINDER}$$

$$\begin{array}{r l}
 & \,1001 \leftarrow a(x) \\
1011 & \overline{)\,1010011} \\
 & \underline{1011} \\
 & 0001011 \\
 & \underline{1011} \\
 & 0000 \quad \underline{\text{NO REMAINDER}}
\end{array}$$


TACKLING THE ENCODER TYPE I
STARTS
TAP
TAP
c
b
a
x
1
0
1
1
g(x) = 1011
m(x) = 0110
END
b
a+c
x+c
x