CO-LAB
AN ASD-ANU COLLABORATION

Error Correction in Real Life

International Standard Book Numbers (ISBN)

Published books have a 13-digit code that is unique to that book. It is usually found on the back cover, or on one of the first pages of the book. It means that if you order a book by the ISBN, you know you're getting the correct one.

ISBNs have an error detection code. Let's see how it works using this book about Hedy Lamarr. She was a super cool lady who helped invent wi-fi. She was also an actress.

Step 1: Find the ISBN

The ISBN for this book is 978-1-4549-2691-7

The final number, 7, is the check code.

Step 2: Add all but the last number using a special formula

You multiply every second number by 3 before adding.

(9x1)+(7x3)+(8x1)+(1x3)+(4x1)+(5x3)

+(4x1)+(9x3)+(2x1)+(6x3)+(9x1)+(1x3)

=9+21+8+3+4+15+4+27+2+18+9+3

=123

Step 3: Divide by 10, and find the remainder

123÷10 = 12 remainder 3

Step 4: Subtract the remainder from 10 to find the checksum

10-3 = 7

As expected!

Try it for some of your own books. If you have some old books, you might see ISBNs that only have 10 digits. These were calculated differently to modern ISBNs. Can you find the old way of calculating them?

What would happen if a digit were entered incorrectly?

What would happen if two digits that were next to each other were swapped?

What if a digit were accidentally inserted or removed?

Can you think of an error that might not be detected?

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Binary Telephone

Maybe you've played *telephone* before- where you whisper a message from friend to friend and see how different the message is by the end of the line. Sometimes, when we send a message using a computer the message changes along the way, too!

The American Standard Code for Information Interchange, or ASCII, is one way the computer changes our letters, numbers and other characters into binary that is ready to store or send to our friends. Sometimes, one of those 1s or 0s gets accidently changed, which means our friend might receive the wrong message! Let's see whether our error correcting code can help us correctly pass messages in binary.

Set Up

1. Write a seven character message in the first column of the grid.
2. Turn each character into binary using the ASCII table and write it in the rows.
3. Calculate the check code for each row and write it at the end of that row. Do the same for the columns.
4. Copy the binary table into the table on the laminated sheet.

Message	Binary ASCII							Check

Play

5. Pass your laminated message sheet to the person on your right.
6. Change exactly one of the 1s or 0s on the sheet you have received.
7. Pass the sheet to your right.
8. Try to decode and error correct the code you have received.

Extension

Try passing the sheet through two people who each make a change. Can you still decode the message? What about three people? More? Do the places where the errors occur make a difference to whether you can decode the message?

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American Standard Code for Information Interchange (ASCII)

010 0001	!	101 0000	P
010 0010	"	101 0001	Q
010 0011	#	101 0010	R
010 0100	$	101 0011	S
010 0101	%	101 0100	T
010 0110	&	101 0101	U
010 0111	'	101 0110	V
010 1000	(	101 0111	W
010 1001	)	101 1000	X
010 1010	*	101 1001	Y
010 1011	+	101 1010	Z
010 1100	,	101 1011	[
010 1101	-	101 1100	\
010 1110	.	101 1101	]
010 1111	/	101 1110	^
011 0000	0	101 1111	_
011 0001	1	110 0000	`
011 0010	2	110 0001	a
011 0011	3	110 0010	b
011 0100	4	110 0011	c
011 0101	5	110 0100	d
011 0110	6	110 0101	e
011 0111	7	110 0110	f
011 1000	8	110 0111	g
011 1001	9	110 1000	h
011 1010	:	110 1001	i
011 1011	;	110 1010	j
011 1100	<	110 1011	k
011 1101	=	110 1100	l
011 1110	>	110 1101	m
011 1111	?	110 1110	n
100 0000	@	110 1111	o
100 0001	A	111 0000	p
100 0010	B	111 0001	q
100 0011	C	111 0010	r
100 0100	D	111 0011	s
100 0101	E	111 0100	t
100 0110	F	111 0101	u
100 0111	G	111 0110	v
100 1000	H	111 0111	w
100 1001	I	111 1000	x
100 1010	J	111 1001	y
100 1011	K	111 1010	z
100 1100	L	111 1011	{
100 1101	M	111 1100	|
100 1110	N	111 1101	}
100 1111	O	111 1110	~

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