LECTURE 5

ERROR DETECTION AND CORRECTION

Example 4

Suppose the following block of 16 bits is to be sent using a checksum of 8 bits.

10101001   00111001

The numbers are added as:

	10101001
	00111001

Sum	11100010
Checksum	00011101

The pattern sent is   10101001   00111001   00011101

Example 5

Now suppose the receiver receives the pattern sent in Example 7 and there is no error.

10101001 00111001 00011101

When the receiver adds the three sections, it will get all 1s, which, after complementing, is all 0s and shows that there is no error.

	10101001
	00111001
	00011101
Sum	11111111
Complement	00000000 means that the pattern is OK.

Example 6

Now suppose there is a burst error of length 5 that affects 4 bits.

10101111   11111001   00011101

When the receiver adds the three sections, it gets

	10101111
	11111001
	00011101
Partial Sum	1 11000101
Carry	1
Sum	11000110
Complement	00111001 the pattern is corrupted.

Correction

Stop and wait

Go Back N

Sliding Window

Hamming Code

Hamming Code

Data and redundancy bits

Number of data bits m	Number of redundancy bits r	Total bits m + r
1	2	3
2	3	5
3	3	6
4	3	7
5	4	9
6	4	10
7	4	11

$$2^r \geq m + r + 1$$

Positions of redundancy bits in Hamming code

11	10	9	8	7	6	5	4	3	2	1
d	**d**	**d**	r_8	**d**	**d**	**d**	r_4	**d**	r_2	r_1

$$2^3, 2^2, 2^1, 2^0$$

Redundancy bits calculation

r_1 will take care of these bits.

11		9		7		5		3		1
d	d	d	r_8	d	d	d	r_4	d	r_2	r_1

r_2 will take care of these bits.

11	10			7	6			3	2	
d	d	d	r_8	d	d	d	r_4	d	r_2	r_1

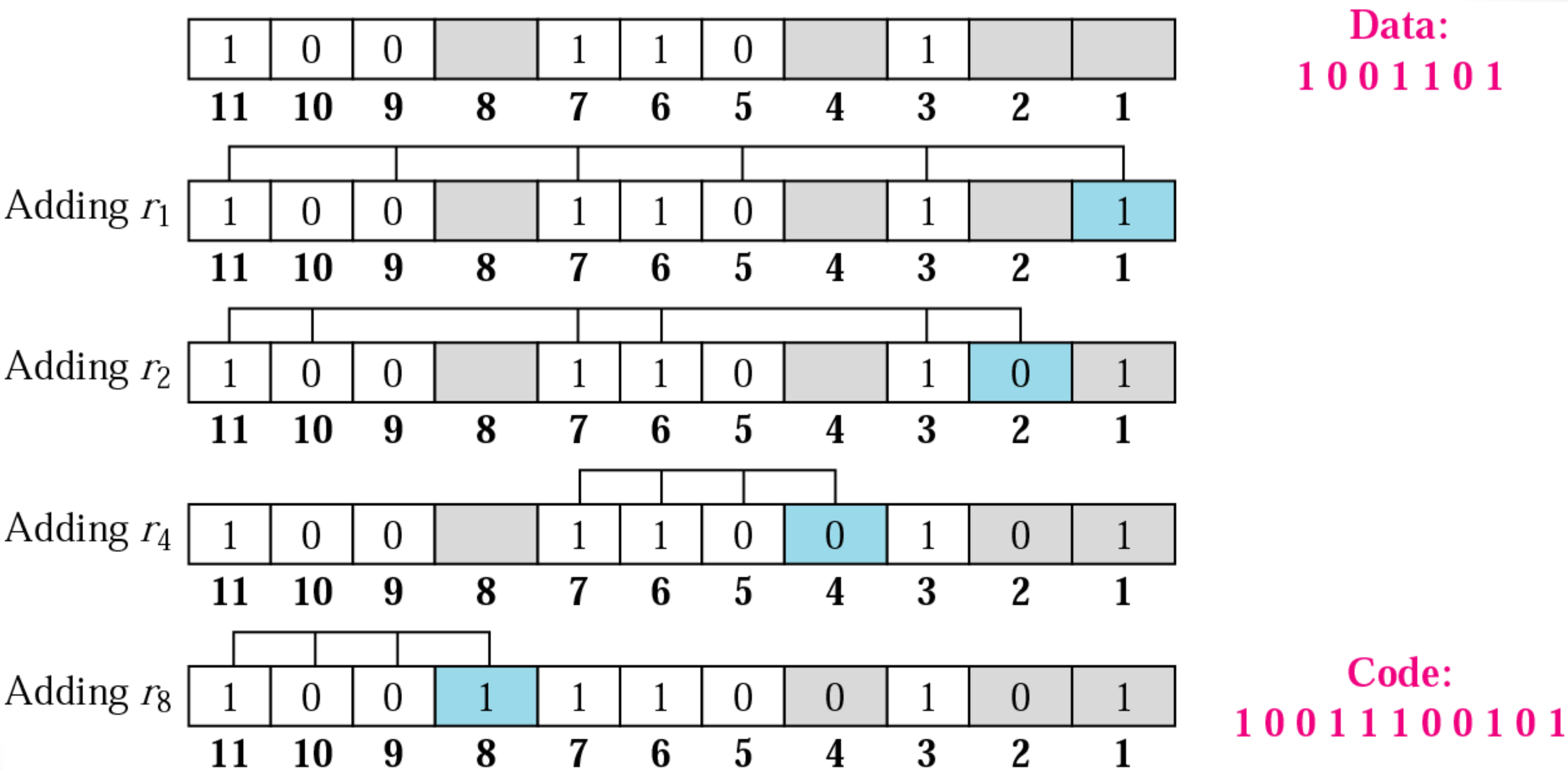
r_4 will take care of these bits.

				7	6	5	4			
d	d	d	r_8	d	d	d	r_4	d	r_2	r_1

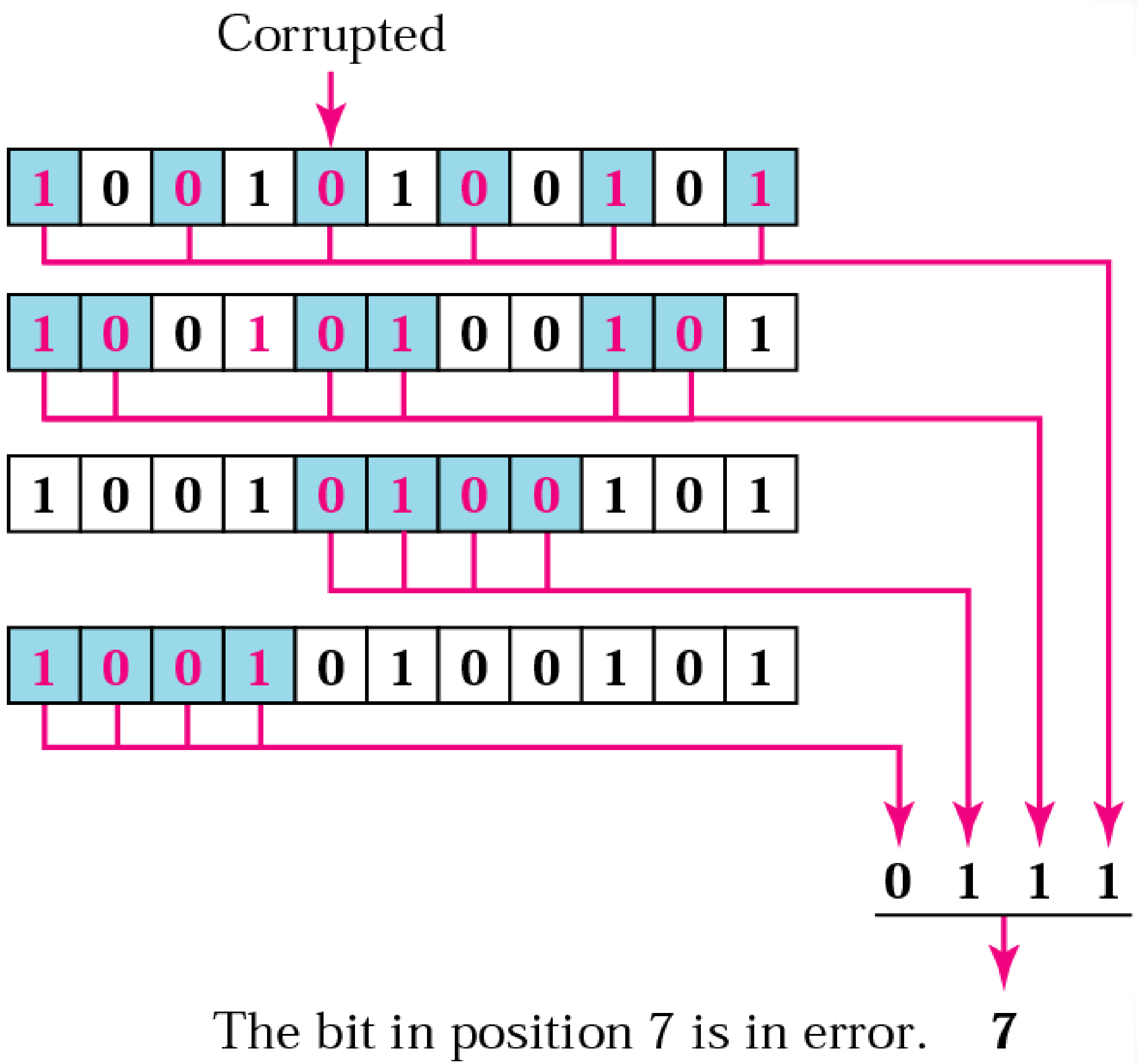
r_8 will take care of these bits.

11	10	9	8							
d	d	d	r_8	d	d	d	r_4	d	r_2	r_1

Example of redundancy bit calculation



Error detection using Hamming code



Burst error correction example