



**CSN08704**

# **Telecommunications**

Huffman/Lempel-Ziv Compression  
Methods

**Data, Audio, Video and Images**

<http://asecuritysite.com/comms>

Prof Bill Buchanan



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# Telecommunications

Huffman Coding

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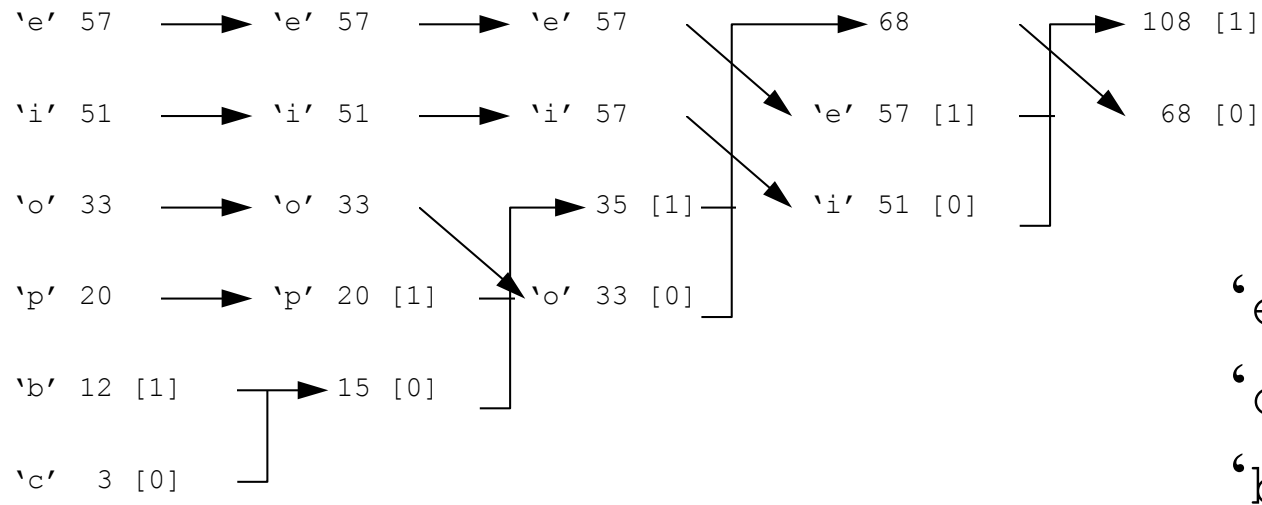
Prof Bill Buchanan

# Huffman Coding

Letter:	'b'	'c'	'e'	'i'	'o'	'p'
No. of occurrences:	12	3	57	51	33	20

'e'	'i'	'o'	'p'	'b'	'c'
57	51	33	20	12	3

[Link](#)



'e'	11	'i'	10
'o'	00	'p'	011
'b'	0101	'c'	0100

# Huffman Coding

How will the following be decoded:

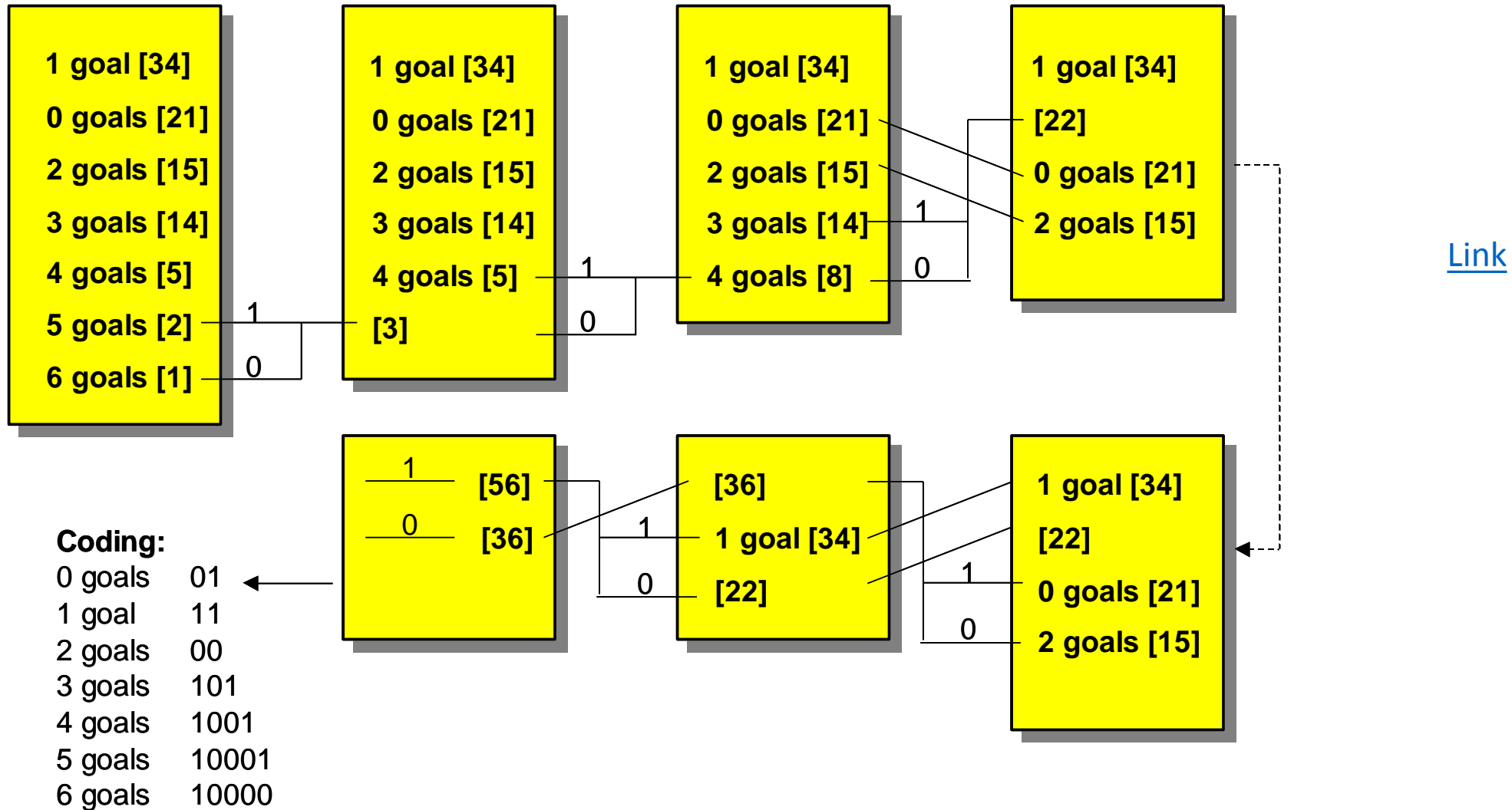
11 00 011 0100 10 011 0100



'e'

'e'	11	'i'	10
'o'	00	'p'	011
'b'	0101	'c'	0100

# Huffman Coding Example



# Huffman Coding (example)

Input: **peter piper picked a picked pepper** [\[Link\]](#)

## Symbol Weight Huffman Code

e	7	00
p	8	10
	5	110
c	2	0101
d	2	0110
i	3	1110
k	2	0111
r	3	1111
a	1	01000
t	1	01001

Coding is: 10 00 01001 00 1111 110 10 1110 10 00 1111 110 10 1110 0101 0111 00 0110  
110 01000 110 10 1110 0101 0111 00 0110 110 10 00 10 10 00 1111



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# **Telecommunications**

Lempel-Ziv Welsh (LZW)

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# Lempel-Ziv

‘The receiver requires a receipt for it. This is  
automatically sent when it is received.’

The diagram shows the original sentence with red boxes around the words 'requires' and 'receipt'. Below the word 'requires' is a dashed line with the number '1' underneath it. Similarly, below the word 'receipt' is a dashed line with the number '1' underneath it. Red arrows point from the word 'requires' in the second line to the word 'requires' in the first line, and from the word 'receipt' in the second line to the word 'receipt' in the first line.

‘The receiver#9#3quires a#20#5pt for it. This is automatically sent wh#6#2 it  
#30#2#47#5ved.’

The diagram shows the sentence with red boxes around the strings '#9#3' and '#20#5'. Below the string '#9#3' is a dashed line with the number '1' underneath it. Similarly, below the string '#20#5' is a dashed line with the number '1' underneath it. Red arrows point from the string '#9#3' in the second line to the string '#9#3' in the first line, and from the string '#20#5' in the second line to the string '#20#5' in the first line.



# Lempel-Ziv Welsh (LZW)

ababacdcdaaaaaaef

Initially fill table with characters used:

0000	'a'	0001	'b'
0010	'c'	0011	'd'
0100	'e'	0101	'f'
0110–1111	empty		

[Link](#)

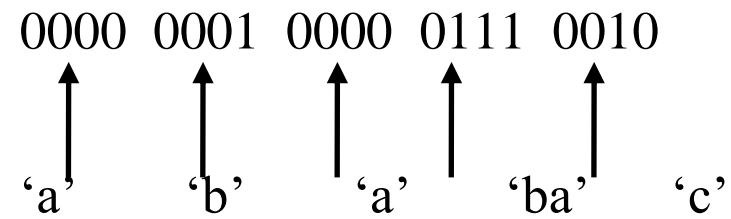
Process "ab" and add to table:

0000	'a'	0001	'b'
0010	'c'	0011	'd'
0100	'e'	0101	'f'
0110	'ab'	0111–1111	empty

# Lempel-Ziv Welsh (LZW)

ababacdcdaaaaaaef

0000	'a'
0001	'b'
0010	'c'
0011	'd'
0100	'e'
0101	'f'
0110	'ab'
0111	'ba'
1000–1111	empty



# Lempel-Ziv Welsh (Example)

**Cows graze in groves on grass which grows in  
grooves in groves** [[Link](#)]

Compressed:

['C', 'o', 'w', 's', ' ', 'g', 'r', 'a', 'z', 'e', ' ', 'i', 'n', 260, 'r',  
'o', 'v', 'e', 259, 'o', 268, 261, 'a', 's', 259, 'w', 'h', 'i', 'c',  
'h', 269, 257, 259, 267, 286, 271, 273, 266, 276, 270,  
272, 's']

256

297

Adding: [256]Co

Adding: [257]ow

Adding: [258]ws

Adding: [259]s

Adding: [260] g

Adding: [261]gr

Adding: [262]ra

Adding: [263]az

Adding: [264]ze

Adding: [265]e

Adding: [266] i



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