

Dictionary-based Compressions ■ How many words do we have in a dictionary? □ Pocket dictionary: about 25,000 words □ Full-size dictionary: about 60,000 words ■ If we will give a sequential number for each of these words, how many bits do we need? □ Pocket dictionary: we only need 15 bits (0 to 32,767) □ Full-size dictionary: we only need 16 bits (0 to 64,535)



Topic 07: Dictionary-based Encoding

Dictionary-based Compressions

- Assume that an English word consists of 6 letters (on average)
- Consider having an English dictionary containing half a million words (without their definition)
 - ☐ This dictionary is searched for each word needs to be encoded
 - ☐ If a match is found,
 - this word is encoded by a pointer to that word (needs 20 bits)
 - □ 1 bit to say that match was found
 - □ 19 bits as a dictionary index to that word

Otherwise.

- the word is encoded without any compression, i.e., a raw word (needs 50 bits on average),
 - □ 1 bit to say that match was not found
 - □ 7 bits to identify the length of the word
 - □ 6 characters per word (on average) × 7 bits per characters
- \square Assume that P is the probability of finding a word in the dictionary

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Topic 07: Dictionary-based Encoding

Dictionary-based Compressions

 \square After reading and compressing N words, the size of the compressed file will be (on average)

$$N \times (20 \times P + 50 \times (1 - P))$$
 bits,

□ Without compression, we need

$$N \times 49$$
 bits

to encode these N words

□ To achieve compression, the following relation must be hold

$$N \times (20 \times P + 50 \times (1 - P)) < N \times 49$$

 $(20 \times P + 50 \times (1 - P)) < 49$
 $-30 \times P + 50 < 49$

or in other word, P must be greater that 1/30!!

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		Topic 07: Dictionary-based Encoding
Statistical-based Vers	us Dictionary	/-based Compressions
Statistical-based compress	sion schemes	
☐ Use a statistical model of the	ne data	
☐ The quality of the achieved	l compression dep	ends on how good that model is
Dictionary-based compres	ssion schemes	
☐ A data string is partitioned	d into sub-strings	of symbols
☐ Each sub-string is encoded	as a dictionary in	dex
☐ The dictionary holds sub-s	trings of symbols	and it may be
Static dictionary		
□ Holds <i>predetermined</i>	<mark>l</mark> strings (<i>image inde</i>	ependent)
□ Sometimes allows st	-	
□ Does not allow string	gs deletion	
Dynamic (adaptive) did	ctionary	
☐ Holds strings <i>previou</i>	usly found in the inp	ut stream (image dependent)
□ Allows strings additi	on and deletion	
☐ Perhaps the most famous d	ictionary-based co	ompression schemes are
LZ77 and LZ78		
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Topic 07: Dictionary-based Encoding **LZ77** ■ LZ77 is a dictionary-based compression scheme described by Ziv and Lempel in 1977, and hence the name LZ77 ■ The main idea of LZ77 is to use *part* of the previously seen input stream as a dictionary (*searching buffer*) ☐ The searching buffer is a sliding window on the input characters/pixels that have recently encoded ■ The encoder scans the search buffer looking for a match to the current data symbol to be encoded ■ If a match is found, it then tries to match as many following symbols as possible ■ The encoder then continues the scan, trying to find longer matches ■ The longest match is selected to generate the token ■ LZ77 token has three parts \square an offset, \square a match length, and □ the code of the next mismatched symbol (from the input stream) *Why?* © Mahmoud R. El-Sakka CS4481/9628: Image Compression

No.	Searching buffer	Data to be encoded	token
1		sir sid eastman easily teases sea sick seal	

No.	Searching buffer	Data to be encoded	token
2		sir sid eastman easily teases sea sick seal s ir sid eastman easily teases sea sick seal	(0, 0, "s")
			1

To.	Searching buffer	Data to be encoded	token
1		sir sid eastman easily teases sea sick seal	
2		ir sid eastman easily teases sea sick seal	(0, 0, "s")
3	Si	r sid eastman easily teases sea sick seal	(0, 0, "i")

		easily teases sea sick seal" usir	
No.	Searching buffer	Data to be encoded sir sid eastman easily teases sea sick seal	token
2	e	ir sid eastman easily teases sea sick seal	(0, 0, "s")
3		r sid eastman easily teases sea sick seal	(0, 0, "i")
4	sir	-	(0, 0, "r")
		-	(-,-,

io.	Searching buffer	Data to be encoded	token
1		sir sid eastman easily teases sea sick seal	
2	:	s ir sid eastman easily teases sea sick seal	(0, 0, "s")
3	5	r sid eastman easily teases sea sick seal	(0, 0, "i")
4	Si	r sid eastman easily teases sea sick seal	(0, 0, "r")
5	siı	sid eastman easily teases sea sick seal	(0, 0, "")
			+

No.	Searching buffer	Data to be encoded	token
1		sir sid eastman easily teases sea sick seal	
2	s	ir sid eastman easily teases sea sick seal	(0, 0, "s")
3	si	· · · · · · · · · · · · · · · · · · ·	(0, 0, "i")
4	sir	•	(0, 0, "r")
5	sir	sid eastman easily teases sea sick seal	(0, 0, " ")
6	sir sid	eastman easily teases sea sick seal	(4, 2, "d")

٥.	Searching buffer	Data to be encoded	token
1	-	sir sid eastman easily teases sea sick seal	
2	S	ir sid eastman easily teases sea sick seal	(0, 0, "s")
3	si	r sid eastman easily teases sea sick seal	(0, 0, "i")
4	sir	sid eastman easily teases sea sick seal	(0, 0, "r")
5	sir	sid eastman easily teases sea sick seal	(0, 0, " ")
6	sir sid	eastman easily teases sea sick seal	(4, 2, "d")
7	sir sid e	astman easily teases sea sick seal	(4, 1, "e")
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No.	Searching buffer	pasily teases sea sick seal" usir	token
1	bearening burier	sir sid eastman easily teases sea sick seal	coken
2	S	ir sid eastman easily teases sea sick seal	(0, 0, "s")
3	si	r sid eastman easily teases sea sick seal	(0, 0, "i")
4	sir	sid eastman easily teases sea sick seal	(0, 0, "r")
5	sir	sid eastman easily teases sea sick seal	(0, 0, " ")
6	sir sid	eastman easily teases sea sick seal	(4, 2, "d")
7	sir sid e	astman easily teases sea sick seal	(4, 1, "e")
8	sir sid ea	stman easily teases sea sick seal	(0, 0, "a")

lo.	Searching buffer	Data to be encoded	token
1		sir sid eastman easily teases sea sick seal	
2	s	ir sid eastman easily teases sea sick seal	(0, 0, "s")
3	si	r sid eastman easily teases sea sick seal	(0, 0, "i")
4	sir	sid eastman easily teases sea sick seal	(0, 0, "r")
5	sir		(0, 0, " ")
6		eastman easily teases sea sick seal	(4, 2, "d")
7		astman easily teases sea sick seal	(4, 1, "e")
8		stman easily teases sea sick seal	(0, 0, "a")
9	sir sid east	man easily teases sea sick seal	(6, 1, "t")

No.	Searching buffer	Data to be encoded	token
1		sir sid eastman easily teases sea sick seal	
2	s	ir sid eastman easily teases sea sick seal	(0, 0, "s")
3	si	r sid eastman easily teases sea sick seal	(0, 0, "i")
4	sir	sid eastman easily teases sea sick seal	(0, 0, "r")
5	sir	sid eastman easily teases sea sick seal	(0, 0, "")
6	sir sid	eastman easily teases sea sick seal	(4, 2, "d")
7		astman easily teases sea sick seal	(4, 1, "e")
8		stman easily teases sea sick seal	(0, 0, "a")
9		man easily teases sea sick seal	(6, 1, "t")
10	sir sid eastm	an easily teases sea sick seal	(0, 0, "m")

To.	Searching buffer	Data to be encoded	token
1	-	sir sid eastman easily teases sea sick seal	
2	s	ir sid eastman easily teases sea sick seal	(0, 0, "s")
3	si	r sid eastman easily teases sea sick seal	(0, 0, "i")
4	sir	sid eastman easily teases sea sick seal	(0, 0, "r")
5	sir	,	(0, 0, " ")
6	sir sid		(4, 2, "d")
7		astman easily teases sea sick seal	(4, 1, "e")
8		stman easily teases sea sick seal	(0, 0, "a")
9		man easily teases sea sick seal	(6, 1, "t")
10	sir sid eastm	an easily teases sea sick seal	(0, 0, "m")
11	sir sid eastman	easily teases sea sick seal	(4, 1, "n")

	Encoding of "sir sid eastman e		
No.	Searching buffer	Data to be encoded	token
1 2		sir sid eastman easily teases sea sick seal ir sid eastman easily teases sea sick seal	(0, 0, "0")
		,	(0, 0, "s")
3		r sid eastman easily teases sea sick seal	(0, 0, "i")
4	sir	sid eastman easily teases sea sick seal	(0, 0, "r")
5	sir	sid eastman easily teases sea sick seal	(0, 0, " ")
6	sir sid	-	(4, 2, "d")
7		astman easily teases sea sick seal	(4, 1, "e")
8		stman easily teases sea sick seal	(0, 0, "a")
9		man easily teases sea sick seal	(6, 1, "t")
10	sir sid eastm	an easily teases sea sick seal	(0, 0, "m")
11	sir sid eastman		(4, 1, "n")
12	sir sid eastman easi	ly teases sea sick seal	(8, 4, "i")

To.	Searching buffer	Data to be encoded	token
1		sir sid eastman easily teases sea sick seal	
2	s	ir sid eastman easily teases sea sick seal	(0, 0, "s")
3	si	r sid eastman easily teases sea sick seal	(0, 0, "i")
4	sir	sid eastman easily teases sea sick seal	(0, 0, "r")
5	sir	sid eastman easily teases sea sick seal	(0, 0, " ")
6	sir sid	eastman easily teases sea sick seal	(4, 2, "d")
7	sir sid e	astman easily teases sea sick seal	(4, 1, "e")
8	sir sid ea	stman easily teases sea sick seal	(0, 0, "a")
9		man easily teases sea sick seal	(6, 1, "t")
10	sir sid eastm	an easily teases sea sick seal	(0, 0, "m")
11	sir sid eastman		(4, 1, "n")
12	sir sid eastman easi	ly teases sea sick seal	(8, 4, "i")
13	sir sid eastman easil	y teases sea sick seal	(0, 0, "I")

No.	Searching buffer	Data to be encoded	token
1	Searching Durier	sir sid eastman easily teases sea sick seal	COKEII
2	S	ir sid eastman easily teases sea sick seal	(0, 0, "s")
3	si	r sid eastman easily teases sea sick seal	(0, 0, "i")
4	sir	sid eastman easily teases sea sick seal	(0, 0, "r")
5	sir	sid eastman easily teases sea sick seal	(0, 0, " ")
6	sir sid	eastman easily teases sea sick seal	(4, 2, "d")
7	sir sid e	astman easily teases sea sick seal	(4, 1, "e")
8		stman easily teases sea sick seal	(0, 0, "a")
9	sir sid east	man easily teases sea sick seal	(6, 1, "t")
10	sir sid eastm	an easily teases sea sick seal	(0, 0, "m")
11	sir sid eastman		(4, 1, "n")
12		ly teases sea sick seal	(8, 4, "i")
13	sir sid eastman easil	y teases sea sick seal	(0, 0, "I")
14	sir sid eastman easily	teases sea sick seal	(0, 0, "y")

īo.	Searching buffer	Data to be encoded	token
1	-	sir sid eastman easily teases sea sick seal	
2	s	ir sid eastman easily teases sea sick seal	(0, 0, "s")
3	si	r sid eastman easily teases sea sick seal	(0, 0, "i")
4	sir	sid eastman easily teases sea sick seal	(0, 0, "r")
5		sid eastman easily teases sea sick seal	(0, 0, " ")
6	sir sid	eastman easily teases sea sick seal	(4, 2, "d")
7		astman easily teases sea sick seal	(4, 1, "e")
8		stman easily teases sea sick seal	(0, 0, "a")
9		man easily teases sea sick seal	(6, 1, "t")
10	sir sid eastm	an easily teases sea sick seal	(0, 0, "m")
11	sir sid eastman	1 -	(4, 1, "n")
12		ly teases sea sick seal	(8, 4, "i")
13		y teases sea sick seal	(0, 0, "I")
14	sir sid eastman easily		(0, 0, "y")
15	sir sid eastman easily t	eases sea sick seal	(7, 1, "t")

token	Data to be encoded	Searching buffer	No.
	sir sid eastman easily teases sea sick seal		1
(0, 0, "s")	ir sid eastman easily teases sea sick seal	S	2
(0, 0, "i")	r sid eastman easily teases sea sick seal	si	3
(0, 0, "r")	sid eastman easily teases sea sick seal	sir	4
(0, 0, " ")	sid eastman easily teases sea sick seal	sir	5
(4, 2, "d")	eastman easily teases sea sick seal	sir sid	6
(4, 1, "e")	astman easily teases sea sick seal		7
(0, 0, "a")	stman easily teases sea sick seal	sir sid ea	8
(6, 1, "t")	man easily teases sea sick seal	sir sid east	9
(0, 0, "m")	an easily teases sea sick seal		10
(4, 1, "n")	easily teases sea sick seal		11
(8, 4, "i")	ly teases sea sick seal		12
(0, 0, "I")	y teases sea sick seal	sir sid eastman easil	13
(0, 0, "y")		sir sid eastman easily	14
(7, 1, "t")		sir sid eastman easily t	15
(8, 3, "e")	s sea sick seal	sir sid eastman easily tease	16

No.	Searching buffer	Data to be encoded	token
1	-	sir sid eastman easily teases sea sick seal	
2	s	ir sid eastman easily teases sea sick seal	(0, 0, "s")
3	si	r sid eastman easily teases sea sick seal	(0, 0, "i")
4	sir	sid eastman easily teases sea sick seal	(0, 0, "r")
5	sir	sid eastman easily teases sea sick seal	(0, 0, " ")
6	sir sid		(4, 2, "d")
7	sir sid e	astman easily teases sea sick seal	(4, 1, "e")
8		stman easily teases sea sick seal	(0, 0, "a")
9	sir sid east	man easily teases sea sick seal	(6, 1, "t")
10	sir sid eastm	an easily teases sea sick seal	(0, 0, "m")
11	sir sid eastman	1 -	(4, 1, "n")
12		ly teases sea sick seal	(8, 4, "i")
13	sir sid eastman easil	y teases sea sick seal	(0, 0, "I")
14	sir sid eastman easily		(0, 0, "y")
15	sir sid eastman easily t	eases sea sick seal	(7, 1, "t")
16	sir sid eastman easily tease		(8, 3, "e")
17	sir sid eastman easily teases	sea sick seal	(2, 1, " ")

	coding of "sir sid eastman e	asily teases sea sick seal " usir	ig LZ77
No.	Searching buffer	Data to be encoded	token
1		sir sid eastman easily teases sea sick seal	
2	3	ir sid eastman easily teases sea sick seal	(0, 0, "s")
3	si	r sid eastman easily teases sea sick seal	(0, 0, "i")
4	sir	sid eastman easily teases sea sick seal	(0, 0, "r")
5	5	sid eastman easily teases sea sick seal	(0, 0, "")
6	sir sid	eastman easily teases sea sick seal	(4, 2, "d")
7	sir sid e	astman easily teases sea sick seal	(4, 1, "e")
8	sir sid ea	stman easily teases sea sick seal	(0, 0, "a")
9	sir sid east	man easily teases sea sick seal	(6, 1, "t")
10	sir sid eastm	an easily teases sea sick seal	(0, 0, "m")
11	sir sid eastman		(4, 1, "n")
12	sir sid eastman easi	ly teases sea sick seal	(8, 4, "i")
13		y teases sea sick seal	(0, 0, "l")
14	sir sid eastman easily	teases sea sick seal	(0, 0, "y")
15	sir sid eastman easily t	eases sea sick seal	(7, 1, "t")
16	sir sid eastman easily tease	s sea sick seal	(8, 3, "e")
17	sir sid eastman easily teases	sea sick seal	(2, 1, " ")
18	sir sid eastman easily teases sea	sick seal	(4, 2, "a")
	,		1 /

Topic 07: Dictionary-based Encoding Encoding of "sir sid eastman easily teases sea sick seal" using LZ77 Data to be encoded Searching buffer No. token sir sid eastman easily teases sea sick seal 2 s ir sid eastman easily teases sea sick seal (0, 0, "s") si r sid eastman easily teases sea sick seal 3 (0, 0, "i") 4 sir sid eastman easily teases sea sick seal (0, 0, "r") sir sid eastman easily teases sea sick seal 5 (0, 0, "") sir sid eastman easily teases sea sick seal 6 (4, 2, "d") sir sid e astman easily teases sea sick seal 7 (4, 1, "e") sir sid ea stman easily teases sea sick seal 8 (0, 0, "a") sir sid east man easily teases sea sick seal 9 (6, 1, "t") sir sid eastm an easily teases sea sick seal 10 (0, 0, "m") sir sid eastman easily teases sea sick seal 11 (4, 1, "n") sir sid eastman easi ly teases sea sick seal 12 (8, 4, "i") 13 sir sid eastman easil y teases sea sick seal (0, 0, "I") teases sea sick seal 14 sir sid eastman easily (0, 0, "y") sir sid eastman easily t eases sea sick seal 15 (7, 1, "t") sir sid eastman easily tease s sea sick seal 16 (8, 3, "e") 17 sir sid eastman easily teases sea sick seal (2, 1, "") 18 sick seal sir sid eastman easily teases sea (4, 2, "a") 19 sir sid eastman easily teases sea sic k seal (30, 3, "c") © Mahmoud R. El-Sakka CS4481/9628: Image Compression 25

E	ncoding of "sir sid eastman e	asily teases sea sick seal" us ir	ıg LZ77
No.	Searching buffer	Data to be encoded	token
1		sir sid eastman easily teases sea sick seal	(0, 0, "a")
2		ir sid eastman easily teases sea sick seal	(0, 0, "s")
3	si ·	,	(0, 0, "i")
	sir	sid eastman easily teases sea sick seal	(0, 0, "r")
5	sir		(0, 0, " ")
6	sir sid		(4, 2, "d")
7		astman easily teases sea sick seal	(4, 1, "e")
8		stman easily teases sea sick seal	(0, 0, "a")
9		man easily teases sea sick seal	(6, 1, "t")
10		an easily teases sea sick seal	(0, 0, "m")
11	sir sid eastman	<u> </u>	(4, 1, "n")
12		ly teases sea sick seal	(8, 4, "i")
13	sir sid eastman easil	y teases sea sick seal	(0, 0, "l")
14	sir sid eastman easily		(0, 0, "y")
15	sir sid eastman easily t	eases sea sick seal	(7, 1, "t")
16	sir sid eastman easily tease		(8, 3, "e")
17	sir sid eastman easily teases	sea sick seal	(2, 1, " ")
18	sir sid eastman easily teases sea	sick seal	(4, 2, "a")
19	sir sid eastman easily teases sea sic	k seal	(30, 3, "c")
20	sir sid eastman easily teases sea sick	seal	(0, 0, "k")

Topic 07: Dictionary-based Encoding Encoding of "sir sid eastman easily teases sea sick seal" using LZ77 Searching buffer No. Data to be encoded token sir sid eastman easily teases sea sick seal 2 s ir sid eastman easily teases sea sick seal (0, 0, "s") si r sid eastman easily teases sea sick seal 3 (0, 0, "i") 4 sir sid eastman easily teases sea sick seal (0, 0, "r") sir sid eastman easily teases sea sick seal 5 (0, 0, "") sir sid eastman easily teases sea sick seal 6 (4, 2, "d") sir sid e astman easily teases sea sick seal 7 (4, 1, "e") sir sid ea stman easily teases sea sick seal 8 (0, 0, "a") sir sid east man easily teases sea sick seal 9 (6, 1, "t") sir sid eastm an easily teases sea sick seal 10 (0, 0, "m") sir sid eastman easily teases sea sick seal (4, 1, "n") 11 sir sid eastman easi ly teases sea sick seal 12 (8, 4, "i") 13 sir sid eastman easil y teases sea sick seal (0, 0, "I") 14 sir sid eastman easily teases sea sick seal (0, 0, "y") sir sid eastman easily t eases sea sick seal 15 (7, 1, "t") sir sid eastman easily tease s sea sick seal 16 (8, 3, "e") 17 sir sid eastman easily teases sea sick seal (2, 1, "") 18 sick seal sir sid eastman easily teases sea (4, 2, "a") 19 sir sid eastman easily teases sea sic k seal (30, 3, "c") seal 20 sir sid eastman easily teases sea sick (0, 0, "k") sir sid eastman easily teases sea sick sea (9, 4, "I") © Mahmoud R. El-Sakka CS4481/9628: Image Compression 27

		Topic 07: Dictionary-bas	ed Encoding
	Decoding using L	Z77	
No.	Searching buffer	token	
1		(
2		(0, 0, "s")	
3		(0, 0, "i")	
4		(0, 0, "r")	
5		(0, 0, " ")	
6		(4, 2, "d")	
7		(4, 1, "e")	
8		(0, 0, "a")	
9		(6, 1, "t")	
10		(0, 0, "m")	
11		(4, 1, "n")	
12		(8, 4, "i")	
13		(0, 0, "l")	
14		(0, 0, "y")	
15		(7, 1, "t")	
16		(8, 3, "e")	
17		(2, 1, " ")	
18			
19		(4, 2, "a")	
		(30, 3, "c")	
20		(0, 0, "k")	
21		(9, 4, "l")	
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	Тор	ic 07: Dictionary-based Encod	ing
	Decoding using LZ77		
No.	Searching buffer	token	
1 2		(O, O, "o")	
	S	(0, 0, "s")	
3		(0, 0, "i")	
4		(0, 0, "r")	
5		(0, 0, "")	
6		(4, 2, "d")	
7		(4, 1, "e")	
8		(0, 0, "a")	
9		(6, 1, "t")	
10		(0, 0, "m")	
11		(4, 1, "n")	
12		(8, 4, "i")	
13		(0, 0, "l")	
14		(0, 0, "y")	
15		(7, 1, "t")	
16		(8, 3, "e")	
17		(2, 1, " ")	
18		(4, 2, "a")	
19		(30, 3, "c")	
20		(0, 0, "k")	
21		(9, 4, "l")	
		(=, -, -, /	
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		ic 07: Dictionary-based End
	Decoding using LZ77	,
No.	Searching buffer	token
1		
2	s	(0, 0, "s")
3	si	(0, 0, "i")
4		(0, 0, "r")
5		(0, 0, "")
6		(4, 2, "d")
7		(4, 1, "e")
8		(0, 0, "a")
9		(6, 1, "t")
10		(0, 0, "m")
11		(4, 1, "n")
12		(8, 4, "i")
13		(0, 0, "I")
14		(0, 0, "y")
15		(7, 1, "t")
16		(8, 3, "e")
17		(2, 1, " ")
18		(4, 2, "a")
19		(30, 3, "c")
20		(0, 0, "k")
21		(9, 4, "l")
		(-, -, -)

	Тор	ic 07: Dictionary-based Encod	ling
•	Decoding using LZ77		
No.	Searching buffer	token	
1 2		(O O "o")	
		(0, 0, "s")	
3		(0, 0, "i")	
4	sir	(0, 0, "r")	
5		(0, 0, "")	
6		(4, 2, "d")	
7		(4, 1, "e")	
8		(0, 0, "a")	
9		(6, 1, "t")	
10		(0, 0, "m")	
11		(4, 1, "n")	
12		(8, 4, "i")	
13		(0, 0, "l")	
14		(0, 0, "y")	
15		(7, 1, "t")	
16		(8, 3, "e")	
17		(2, 1, "")	
18		(4, 2, "a")	
19		(30, 3, "c")	
20		(0, 0, "k")	
21		(9, 4, "l")	
[(0, 1, 1)	
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	10p	ic 07: Dictionary-based Enco	uil
Decoding using LZ77			
No.	Searching buffer	token	
1			
2		(0, 0, "s")	
3	si	(0, 0, "i")	
4	sir	(0, 0, "r")	
5	sir	(0, 0, "")	
6		(4, 2, "d")	
7		(4, 1, "e")	
8		(0, 0, "a")	
9		(6, 1, "t")	
10		(0, 0, "m")	
11		(4, 1, "n")	
12		(8, 4, "i")	
13		(0, 0, "l")	
14		(0, 0, "y")	
15		(7, 1, "t")	
16		(8, 3, "e")	
17		(2, 1, " ")	
18		(4, 2, "a")	
19		(30, 3, "c")	
20		(0, 0, "k")	
21		(9, 4, "l")	

_	Top	ic 07: Dictionary-based Encod	ing
Decoding using LZ77			
No.	Searching buffer	token	
1		(0, 0, "a")	
2		(0, 0, "s")	
3		(0, 0, "i")	
4		(0, 0, "r")	
5		(0, 0, "")	
6	sir sid	(4, 2, "d")	
7		(4, 1, "e")	
8		(0, 0, "a")	
9		(6, 1, "t")	
10		(0, 0, "m")	
11		(4, 1, "n")	
12		(8, 4, "i")	
13		(0, 0, "l")	
14		(0, 0, "y")	
15		(7, 1, "t")	
16		(8, 3, "e")	
17		(2, 1, " ")	
18		(4, 2, "a")	
19		(30, 3, "c")	
20		(0, 0, "k")	
21		(9, 4, "l")	
		(0, 7, 1)	
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	Decoding using LZ77	
No.	Searching buffer	token
1		
2	S	(0, 0, "s")
3	si	(0, 0, "i")
4		(0, 0, "r")
5	sir	(0, 0, " ")
6	sir sid	(4, 2, "d")
7	sir sid e	(4, 1, "e")
8		(0, 0, "a")
9		(6, 1, "t")
10		(0, 0, "m")
11		(4, 1, "n")
12		(8, 4, "i")
13		(0, 0, "l")
14		(0, 0, "y")
15		(7, 1, "t")
16		(8, 3, "e")
17		(2, 1, " ")
18		(4, 2, "a")
19		(30, 3, "c")
20		(0, 0, "k")
21		(9, 4, "l")

	Top	c 07: Dictionary-	based Encodi
Decoding using LZ77			
No.	Searching buffer	token	
1			
2		(0, 0, "s")	
3	si	(0, 0, "i")	
4	sir	(0, 0, "r")	
5	sir	(0, 0, " ")	
6	sir sid	(4, 2, "d")	
7	sir sid e	(4, 1, "e")	
8	sir sid ea		
9		(6, 1, "t")	
10		(0, 0, "m")	
11		(4, 1, "n")	
12		(8, 4, "i")	
13		(0, 0, "l")	
14		(0, 0, "y")	
15		(7, 1, "t")	
16		(8, 3, "e")	
17		(2, 1, " ")	
18		(4, 2, "a")	
19		(30, 3, "c")	
20		(0, 0, "k")	
21		(9, 4, "l")	
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Decoding using LZ77		
No.	Searching buffer	token
1		
2	s	(0, 0, "s")
3	si	(0, 0, "i")
4	sir	(0, 0, "r")
5	sir	(0, 0, "")
6	sir sid	(4, 2, "d")
7	sir sid e	(4, 1, "e")
8	sir sid ea	(0, 0, "a")
9	sir sid east	
10		(0, 0, "m")
11		(4, 1, "n")
12		(8, 4, "i")
13		(0, 0, "I")
14		(0, 0, "y")
15		(7, 1, "t")
16		(8, 3, "e")
17		(2, 1, " ")
18		(4, 2, "a")
19		(30, 3, "c")
20		(0, 0, "k")
21		(9, 4, "I")

		Top	ic v/: Diction	ary-based Encod
Decoding using LZ77				
No	. Search	ing buffer	token	
1				
_ 2			(0, 0, "s")	
3		si	(0, 0, "i")	
4		sir	(0, 0, "r")	
5		sir	(0, 0, " ")	
6		sir sid	(4, 2, "d")	
7		sir sid e	(4, 1, "e")	
8		sir sid ea		
9		sir sid east	(6, 1, "t")	
1		sir sid eastm	(0, 0, " <mark>m</mark> ")	
1:			(4, 1, "n")	
1:			(8, 4, "i")	
1:			(0, 0, "l")	
1.			(0, 0, "y")	
1			(7, 1, "t")	
1			(8, 3, "e")	
1	'		(2, 1, " ")	
1:	1		(4, 2, "a")	
1:			(30, 3, "c")	
2			(0, 0, "k")	
2:			(9, 4, "l")	

Decoding using LZ77		
No.	Searching buffer	token
1		
2	s	(0, 0, "s")
3	si	(0, 0, "i")
4		(0, 0, "r")
5		(0, 0, " ")
6	sir sid	(4, 2, "d")
7	sir sid e	(4, 1, "e")
8	sir sid ea	(0, 0, "a")
9	sir sid east	(6, 1, "t")
10	sir sid eastm	(0, 0, "m")
11	sir sid eastman	(4, 1, "n")
12		(8, 4, "i")
13		(0, 0, "I")
14		(0, 0, "y")
15		(7, 1, "t")
16		(8, 3, "e")
17		(2, 1, "")
18		(4, 2, "a")
19		(30, 3, "c")
20		(0, 0, "k")
21		(9, 4, "1")

		Тор	ic 07: Dictionary-based Encodin
Decoding using LZ77			
1	No.	Searching buffer	token
	1		(0, 0, ", ")
	2		
	3		(0, 0, "i")
	4		(0, 0, "r")
	5		(0, 0, " ")
	6	sir sid	(4, 2, "d")
	7	sir sid e	(4, 1, "e")
	8	sir sid ea	(0, 0, "a")
	9	sir sid east	(6, 1, "t")
	10	sir sid eastm	(0, 0, "m")
	11	sir sid eastman	(4, 1, "n")
	12	sir sid eastman easi	(8, 4, "i")
	13		(0, 0, "l")
	14		(0, 0, "y")
	15		(7, 1, "t")
	16		(8, 3, "e")
	17		(2, 1, " ")
	18		(4, 2, "a")
	19		(30, 3, "c")
	20		(0, 0, "k")
<u> </u>	21		(9, 4, "I")
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S Marimoud R. El-Saki	ка	39	CS4461/9026. Image Compression

	Тор	ic 07: Dictionary-based Encoding
Decoding using LZ77		
No.	Searching buffer	token
1		
2	S	
3	si	(0, 0, "i")
4		(0, 0, "r")
5	sir	(0, 0, " ")
6	sir sid	(4, 2, "d")
7	sir sid e	(4, 1, "e")
8	sir sid ea	(0, 0, "a")
9	sir sid east	-
10	sir sid eastm	(0, 0, "m")
11	sir sid eastman	
12	sir sid eastman easi	
13	sir sid eastman easil	
14		(0, 0, "y")
15		(7, 1, "t")
16		(8, 3, "e")
17		(2, 1, "")
18		(4, 2, "a")
19		(30, 3, "c")
20		(0, 0, "k")
21		(9, 4, "I")
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		100	c 07: Dictionary-based	Linco
Decoding using LZ77				
N	· ·	Searching buffer	token	
	1			
_ :	2	S	(0, 0, "s")	
_ :	3	si	(0, 0, "i")	
	4	sir	(0, 0, "r")	
	5	sir	(0, 0, "")	
	6	sir sid	(4, 2, "d")	
	7	sir sid e	(4, 1, "e")	
	8	sir sid ea	(0, 0, "a")	
	9	sir sid east	(6, 1, "t")	
1	LO	sir sid eastm	(0, 0, "m")	
1	L1	sir sid eastman	(4, 1, "n")	
1	L2	sir sid eastman easi	(8, 4, "i")	
1	L3	sir sid eastman easil	(0, 0, "I")	
1	L4	sir sid eastman easily	(0, 0, " <mark>y</mark> ")	
1	L5		(7, 1, "t")	
1	L6		(8, 3, "e")	
1	L7		(2, 1, " ")	
1	L8		(4, 2, "a")	
1	L9		(30, 3, "c")	
2	20		(0, 0, "k")	
2	21		(9, 4, "I")	
_	,			

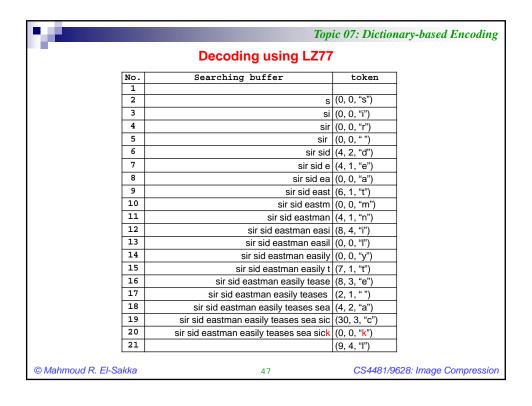
Decoding using LZ77		
No.	Searching buffer	token
1	bearening barrer	CORCII
2	S	(0, 0, "s")
3		(0, 0, "i")
4		(0, 0, "r")
5	sir	(0, 0, " ")
6	sir sid	(4, 2, "d")
7	sir sid e	(4, 1, "e")
8	sir sid ea	(0, 0, "a")
9	sir sid east	
10	sir sid eastm	(0, 0, "m")
11	sir sid eastman	(4, 1, "n")
12	sir sid eastman easi	(8, 4, "i")
13	sir sid eastman easil	(0, 0, "I")
14	sir sid eastman easily	(0, 0, "y")
15	sir sid eastman easily t	(7, 1, "t")
16		(8, 3, "e")
17		(2, 1, " ")
18		(4, 2, "a")
19		(30, 3, "c")
20		(0, 0, "k")
21		(9, 4, "l")

		Тор	ic 07: Dictionary-based Encodir
Decoding using LZ77			
[1	No.	Searching buffer	token
	1		(0, 0, "-")
	2		(0, 0, "s")
	3		(0, 0, "i")
	4		(0, 0, "r")
	5		(0, 0, " ")
	6	sir sid	(4, 2, "d")
	7	sir sid e	(4, 1, "e")
	8	sir sid ea	(0, 0, "a")
	9	sir sid east	(6, 1, "t")
	10	sir sid eastm	(0, 0, "m")
	11	sir sid eastman	(4, 1, "n")
	12	sir sid eastman easi	(8, 4, "i")
	13	sir sid eastman easil	(0, 0, "l")
	14	sir sid eastman easily	(0, 0, "y")
	15	sir sid eastman easily t	(7, 1, "t")
	16	sir sid eastman easily tease	(8, 3, "e")
	17	·	(2, 1, "")
	18		(4, 2, "a")
	19		(30, 3, "c")
	20		(0, 0, "k")
	21		(9, 4, "I")
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		Тор	ic 07: Dictionary-based Encoding
Decoding using LZ77			
Ī	No.	Searching buffer	token
	1		
	2	s	(0, 0, "s")
	3	si	(0, 0, "i")
	4	sir	(0, 0, "r")
	5	sir	(0, 0, " ")
	6	sir sid	(4, 2, "d")
	7	sir sid e	(4, 1, "e")
	8		(0, 0, "a")
	9	sir sid east	
	10	sir sid eastm	(0, 0, "m")
	11	sir sid eastman	
	12	sir sid eastman easi	(8, 4, "i")
	13	sir sid eastman easil	
	14	sir sid eastman easily	(0, 0, "v")
	15	sir sid eastman easily t	(7, 1, "t")
	16	sir sid eastman easily tease	(8, 3, "e")
	17	sir sid eastman easily teases	(2, 1, " ")
	18	,	(4, 2, "a")
	19		(30, 3, "c")
	20		(0, 0, "k")
F	21		(9, 4, "I")
L			
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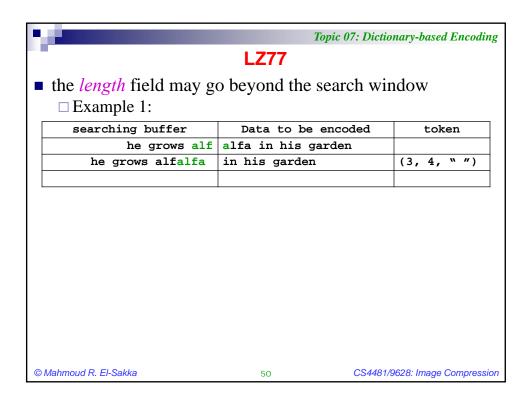
		Top	ic 07: Dictionary-based Encodi
Decoding using LZ77			
[No.	Searching buffer	token
	1		(0, 0, ", ")
1	2		(0, 0, "s")
	3		(0, 0, "i")
	4		(0, 0, "r")
	5	sir	(0, 0, " ")
	6	sir sid	(4, 2, "d")
	7	sir sid e	(4, 1, "e")
	8	sir sid ea	(0, 0, "a")
	9	sir sid east	(6, 1, "t")
	10	sir sid eastm	(0, 0, "m")
	11	sir sid eastman	(4, 1, "n")
Ī	12	sir sid eastman easi	(8, 4, "i")
	13	sir sid eastman easil	(0, 0, " ")
Ī	14	sir sid eastman easily	(0, 0, "y")
	15	sir sid eastman easily t	
Ī	16	sir sid eastman easily tease	
	17		(2, 1, "")
	18	sir sid eastman easily teases sea	
İ	19		(30, 3, "c")
ţ	20		(0, 0, "k")
	21		(9, 4, "I")
L			
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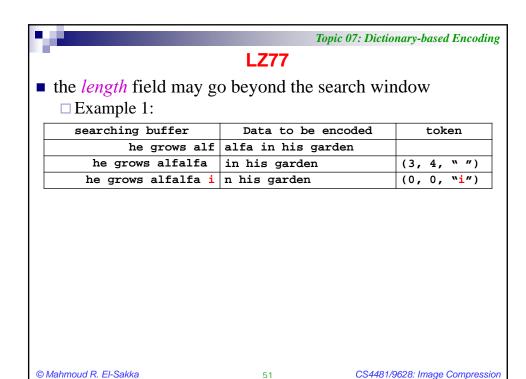
		Top	ic 07: Dictionary-based Encodin	
Decoding using LZ77				
	No.	Searching buffer	token	
	1			
	2	s	(0, 0, "s")	
	3	si	(0, 0, "i")	
	4	sir	(0, 0, "r")	
	5	sir	(0, 0, "")	
	6	sir sid	(4, 2, "d")	
	7	sir sid e	(4, 1, "e")	
	8	sir sid ea	(0, 0, "a")	
	9	sir sid east		
	10	sir sid eastm	(0, 0, "m")	
	11	sir sid eastman		
	12	sir sid eastman easi	(8, 4, "i")	
	13	sir sid eastman easil	(0, 0, "l")	
	14	sir sid eastman easily	(0, 0, "y")	
	15	sir sid eastman easily t		
	16	sir sid eastman easily tease	(8, 3, "e")	
	17	sir sid eastman easily teases	(2, 1, "")	
	18	sir sid eastman easily teases sea		
	19	sir sid eastman easily teases sea sic	(30, 3, "c")	
	20	,	(0, 0, "k")	
	21		(9, 4, "I")	
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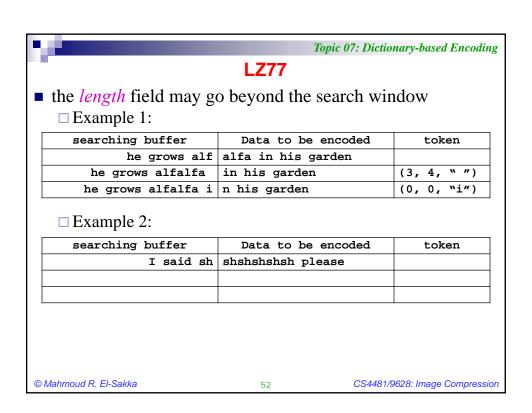


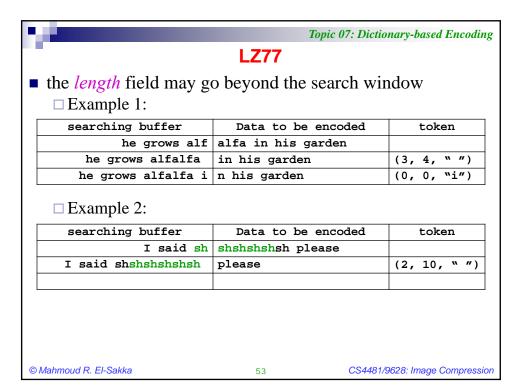
	Topo	ic 07: Dictionary-based Encoding
•	Decoding using LZ77	
No.	Searching buffer	token
1		
2		(0, 0, "s")
3	si	(0, 0, "i")
4		(0, 0, "r")
5	sir	(0, 0, "")
6	sir sid	(4, 2, "d")
7		(4, 1, "e")
8	sir sid ea	(0, 0, "a")
9	sir sid east	(6, 1, "t")
10	sir sid eastm	(0, 0, "m")
11	sir sid eastman	
12	sir sid eastman easi	(8, 4, "i")
13	sir sid eastman easil	(0, 0, "l")
14	sir sid eastman easily	(0, 0, "y")
15	sir sid eastman easily t	(7, 1, "t")
16	sir sid eastman easily tease	(8, 3, "e")
17		
18	sir sid eastman easily teases sea	
19	sir sid eastman easily teases sea sic	
20	sir sid eastman easily teases sea sick	
21	sir sid eastman easily teases sea sick seal	
	· · · · · · · · · · · · · · · · · · ·	

LZ77 the length field may go beyond the searching window Example 1: searching buffer Data to be encoded token he grows alf alfa in his garden









he <i>length</i> field may g □ Example 1:	to beyond the search wi	indow
searching buffer	Data to be encoded	token
he grows alf	alfa in his garden	
he grows alfalfa	in his garden	(3, 4, "")
he grows alfalfa i	n his garden	(0, 0, "i")
□ Example 2: searching buffer	Data to be encoded	token
I said sh	shshshsh please	
I said shshshshsh	please	(2, 10, " "
I said shshshshsh p	lease	(0, 0, "p")
	•	•

