3.12 Code 39 - barcode generation

Write a program in the MIPS assembly language which encodes a text using Code 39 barcode.

Code 39 description

Code 39 encodes 43 symbols. The start and stop symbol is *. It can not be used in encoded data. There are two widths of bars and spaces. The thickness ratio of wide and thin bars and spaces may vary from 2,2:1 to 3:1 (in a given barcode it is constant). Each symbol consists of five bars and four spaces. The size of the space between two characters is not defined – usually it equals the width of thin bar or space.

Code 39 consists of:

- start symbol *,
- encoded data,
- check symbol,
- stop symbol.

Check symbol

The check symbol is calculated according to the formula:

The check symbol is calculated according to the formula:
$$check_symbol_value = \left(\sum_{i=1}^{data_count} data_value[i]\right) mod \ 43$$
Character encoding

Character encoding

The encoding of characters is presented in table 1. Last column contains relative widths of bars (B) and spaces (S). Digit 2 represents wide bar or space, digit 1 – thin bar or space.

Table 1. Character codes

Value	Char	В	s	В	s	В	S	В	s	В	
0	0	1	1	1	2	2	1	2	1	1	
1	1	2	1	1	2	1	1	1	1	2	
2	2	1	1	2	2	1	1	1	1	2	
3	3	2	1	2	2	1	1	1	1	1	
4	4	1	1	1	2	2	1	1	1	2	
5	5	2	1	1	2	2	1	1	1	1	
6	6	1	1	2	2	2	1	1	1	1	
7	7	1	1	1	2	1	1	2	1	2	
8	8	2	1	1	2	1	1	2	1	1	
9	9	1	1	2	2	1	1	2	1	1	
10	A	2	1	1	1	1	2	1	1	2	
11	В	1	1	2	1	1	2	1	1	2	
12	C	2	1	2	1	1	2	1	1	1	
13	D	1	1	1	1	2	2	1	1	2	
14	Е	2	1	1	1	2	2	1	1	1	
15	F	1	1	2	1	2	2	1	1	1	
16	G	1	1	1	1	1	2	2	1	2	
17	Н	2	1	1	1	1	2	2	1	1	
18	I	1	1	2	1	1	2	2	1	1	
19	J	1	1	1	1	2	2	2	1	1	
20	K	2	1	1	1	1	1	1	2	2	

21											
23 N 1 1 1 1 1 2 1 1 2 2 24 O 2 1 1 1 1 2 1 1 2 1 25 P 1 1 2 1 2 1 1 2 1 26 Q 1 1 1 1 1 1 1 2 2 2 27 R 2 1 1 1 1 1 1 2 2 1 28 S 1 1 2 1 1 1 2 2 1 29 T 1 1 1 1 1 2 1 2 2 1 30 U 2 2 1 1 1 1 1 1 2 2 1 31 V 1 2 2 1 1 1 1 1 1 2 32 W 2 2 2 1 1 1 1 1 1 1 2 32 W 2 2 2 1 1 1 1 1 1 1 33 X 1 2 1 1 2 1 1 1 2 34 Y 2 2 1 1 2 1 1 1 2 34 Y 2 2 1 1 2 1 1 1 1 35 Z 1 2 2 1 2 1 1 1 1 36 - 1 2 1 1 1 1 1 2 1 2 37 . 2 2 1 1 1 1 1 2 1 2 38 space 1 2 2 1 1 1 1 2 1 1 39 \$ 1 2 1 2 1 2 1 1 1 40 / 1 2 1 2 1 2 1 2 1 41 + 1 2 1 1 1 2 1 2 1	21	L	1	1	2	1	1	1	1	2	2
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31 V 1 2 2 1 1 1 1 1 2 32 W 2 2 2 1<	29	T	1	1	1	1	2	1	2	2	1
32 W 2 2 2 1 </th <th>30</th> <th>U</th> <th>2</th> <th>2</th> <th>1</th> <th>1</th> <th>1</th> <th>1</th> <th>1</th> <th>1</th> <th>2</th>	30	U	2	2	1	1	1	1	1	1	2
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37 . 2 2 1 1 1 1 2 1 1 38 space 1 2 2 1 1 1 2 1 1 39 \$ 1 2 1 2 1 2 1 1 1 40 / 1 2 1 2 1 1 1 2 1 41 + 1 2 1 1 1 2 1 2 1 2 1 42 % 1 1 1 2 1 2 1 2 1 2 1	35	Z	1	2	2	1	2	1	1	1	1
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38 space 1 2 2 1 1 1 2 1 1 39 \$ 1 2 1 2 1 2 1 1 1 40 / 1 2 1 2 1 1 1 2 1 41 + 1 2 1 1 1 2 1 2 1 2 1 42 % 1 1 1 2 1 2 1 2 1 2 1	37		2	2	1	1	1	1	2	1	1
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40 / 1 2 1 2 1 1 1 2 1 41 + 1 2 1 1 1 2 1 2 1 42 % 1 1 1 2 1 2 1 2 1 2 1	39		1	2	1	2	1	2	1	1	1
42 % 1 1 1 2 1 2 1 2 1	40	/	1	2	1	2	1	1	1	2	1
/ *	41	+	1	2	1	1	1	2	1	2	1
* 1211211	42	%	1	1	1	2	1	2	1	2	1
	> <	*	1	2	1	1	2	1	2	1	1

Input

- the width in pixels of narrowest bar,
- text to be encoded.

Output

- BMP file containing the barcode image:
 - Sub format: 24 bits RGB no compression,
 - Image size: 600x50 px,
 - Colors: bars black, background white.
- file name: "output.bmp"

Remarks:

1. Do not store bars and spaces patterns in coding table as character strings.

References:

- [1] BMP file format see section 4.2
- [2] "Code 39", https://en.wikipedia.org/wiki/Code_39
- [3] Example images, http://galera.ii.pw.edu.pl/~zsz/ecoar/images/barcodes
- [4] Example program for bmp reading/writing,

http://galera.ii.pw.edu.pl/~zsz/ecoar/bmp/bmp_mips.zip