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Assignment title: HW # 1  
Submission title: Assignment 1  
File name: 190101076\_HW1.pdf  
File size: 92.93K  
Page count: 3  
Word count: 793  
Character count: 2,662  
Submission date: 08-Feb-2021 11:16AM (UTC+0530)  
Submission ID: 1504264461

### Assignment 1

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February 7, 2021

#### 1

So, in our language  $L$ , we will be given  $3 \times N$  matrix as input string where  $N \geq 0$ . As we process the input matrix we will be having 2 possibilities either carry is there or not. So, based on this fact I will be having 3 states one for carry( $q_1$ ), one without carry( $q_0$ ) and one dead state( $q_2$ ) for treating that this can never be in our language  $L$ .

We will be starting at  $q_0$  as there is no initial carry. Taking  $\begin{bmatrix} a \\ b \\ c \end{bmatrix}$  as input if  $(a+b) \bmod 2 = (c) \bmod 2$  where mod denotes remainder as divided by 2 and greater than equal to 0. So, if we are at  $q_0$  only  $\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$  these

possibilities are possible and all other will be gone to dead states. Here  $\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$  will remain at  $q_0$  and other value  $\begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}$  will lead to transition to  $q_2$ , as it will provide carry.

Next if we are at  $q_1$ , then taking  $\begin{bmatrix} a \\ b \\ c \end{bmatrix}$  as input if  $(a+b+1) \bmod 2 = (c) \bmod 2$  where mod denotes remainder as divided by 2 and greater than equal to 0.

So, if we are at  $q_1$  only  $\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$  these possibilities are possible and

all other will be gone to dead state. Here  $\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}$  these will remain at  $q_1$  as they generate carry and  $\begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$  will lead to  $q_2$ .