

## Project:

4. (a) For example, if the input number is 13, then assume the tape is initially 1011. To halve this number (discarding any remainder), the answer should be 6, which according to our convention is 011. What we can see from here is just removing the first cell and move other bits forwardly.

(b) Think of multiplication by 3 as shifting by one cell and then adding that to the original number. For example, 1101  $\rightarrow$  11010, 11010 + 1101, where we will get 100111, Output here should be 111001. Special consideration for some numbers are needed here.

(c) If the first cell is 0, it's even, otherwise odd (reverse).

First fact: [http://homepages.math.uic.edu/~scole3/mcs260\\_fall2011/binary.pdf](http://homepages.math.uic.edu/~scole3/mcs260_fall2011/binary.pdf)

We will need to combine the previous Turing Machines to achieve this question.

5. What we need to consider here is the number of 'u' between b and w. Tips: You might need to mark the first tape cell as 0 and consider three different paths(B, U, W)