

1. Consider the following Turing Machine.

State	Input	Write	Move	Next
0	B	B		Accept
	0	0	L	0
	1	1	L	1
1	B	B		Fail
	0	0	L	1
	1	1	L	0

Determine what happens when the Turing Machine is run with the following inputs initially on the tape.

- (a) 0001
 - (b) 0111
 - (c) 0110
 - (d) 0101010001
 - (e) 000000000000000111
 - (f) 00
 - (g)
2. Give the state table for a Turing Machine that appends a parity bit to a tape with a string of consecutive 0's and 1's.
 3. Construct a Turing Machine to compute the sequence 0_1_0_1_0_1..., that is, 0 blank 1 blank 0 blank, etc [1].
 4. Give the state table for a Turing Machine that multiplies a string of consecutive 0's and 1's by 2. The machine should treat the initial contents of the tape as a natural number written in binary form.
 5. Give the state table for a Turing Machine that adds 1 to a string of consecutive 0's and 1's.
 6. Give the state table for a Turing Machine that subtracts 1 to a string of consecutive 0's and 1's.
 7. List all words of length at most three in Σ^* where Σ is:
 - (a) $\{0, 1\}$
 - (b) $\{a, b, c\}$
 - (c) $\{\}$

8. Design Turing Machines to recognise the following languages:

(a) $\{0^n 1^n \mid n \geq 1\}$

(b) $\{ww \mid w \in \{0, 1\}^*\}$

References

- [1] A. M. Turing. On computable numbers, with an application to the entscheidungsproblem. *Proceedings of the London Mathematical Society*, s2-42(1):230–265, 1937.