# Finite State Machines

A Turing machine has states SB, S0, S1, SR and ST. SB is the start state and ST is the stop state. The machine stores tape that is infinitely long in one direction. The machines alphabet is 0, 1, #, x, y and square where square is the symbol used to indicate a blank cell on the tape.

The transition rules for the Turing machine are written as follows:

Complete the following questions based on the Turing Machine above:

1. On paper draw the Finite State Machine that represents this Turing Machine.

Diagram

Description automatically generated

1. Complete the following trace for the Turing Machine above. If you don’t want to fill out every box then only complete the boxes in each row that have changed:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | … |  |
| **0** | 1 | # | \_ | \_ | \_ | … | SB |  | 0 | y | **#** | 0 | \_ | \_ | … | S1 |
| x | **1** | # | \_ | \_ | \_ | … | S0 |  | 0 | y | # | **0** | \_ | \_ | … | S1 |
| x | 1 | **#** | \_ | \_ | \_ | … | S0 |  | 0 | y | # | 0 | **\_** | \_ | … | S1 |
| x | 1 | # | **\_** | \_ | \_ | … | S0 |  | 0 | y | # | **0** | 1 | \_ | … | SR |
| x | 1 | **#** | 0 | \_ | \_ | … | SR |  | 0 | y | **#** | 0 | 1 | \_ | … | SR |
| x | **1** | # | 0 | \_ | \_ | … | SR |  | 0 | **y** | # | 0 | 1 | \_ | … | SR |
| **x** | 1 | # | 0 | \_ | \_ | … | SR |  | 0 | y | **#** | 0 | 1 | \_ | … | SB |
| 0 | **1** | # | 0 | \_ | \_ | … | SB |  | 0 | y | # | **0** | 1 | \_ | … | ST |

1. What does x and y represent in this Turing Machine?

They represent the numbers being copied. They are placeholder values. X represents 0 and y represents 1.

1. What does this Turing Machine do?

This Turing machines copies a binary number or copies a string or copies a bit pattern.

1. Explain what a Universal Turing Machine is..

A Turing machine that can execute/simulate the behaviour of any other Turing Machine. The UTM acts as an interpreter.