CSC6033 Module 07 In Class Exercise 07
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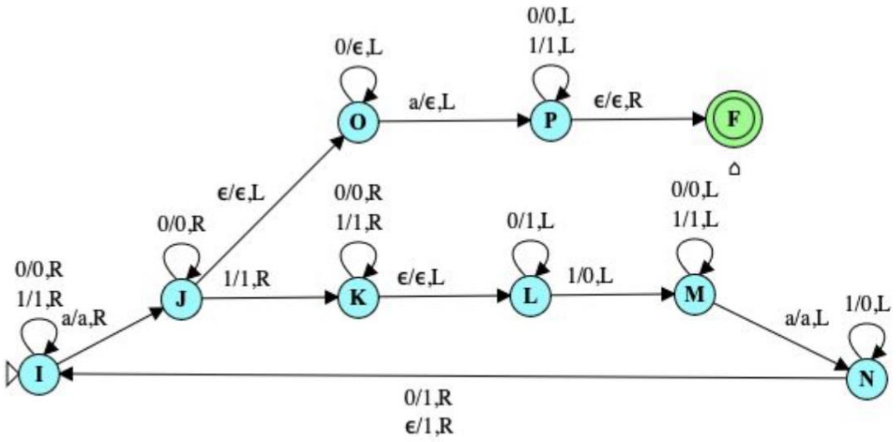
Turing Machine-
Sum of two binary numbers



Example: Binary sum of numbers 1101 and 11 (13 + 3)

Start in state (I)

1.) Read ‘1’ from tape, write ‘1’ to tape move tape right, Remain in state (I)

1 1 | 0 | 1 | a | 1 | 1 |

2.) Read ‘1’ from tape, write ‘1’ to tape, move tape right, remain in state (I)

1 1 0 | 1 | a | 1 | 1 |

3.) Read ‘0’ from tape, write ‘0’ to tape, move tape right, remain in state (I)

1 | 1 0 1 | a | 1 | 1 |

4.) Read ‘1’ from tape, write ‘1’ to tape, move tape right, remain in state (I)

1 | 1 | 0 1 a | 1 | 1 |

5.) Read ‘a’ from tape, write ‘a’ to tape, move tape right, transition from state (I) to (J)

1 | 1 | 0 | 1 a | 1 | 1 |

6.) Read ‘1’ from tape, write ‘1’ to tape, move tape right, transition from state (J) to (K)

1 | 1 | 0 | 1 | a 1 1 |

7.) read ‘1’ from tape, write ‘1’ to tape, move tape right, remain in state (K)

1 | 1 | 0 | 1 | a | 1 1

8.) read ‘**ε**’ from tape, write ‘**ε**’ to tape, move tape left, Transition from state (K) to (L)

1 | 1 | 0 | 1 | a | 1 | 1 |

9.) read ‘1’ from tape, write ’0’ to tape, move tape left, Transition from state (L) to (M)

1 | 1 | 0 | 1 | a | 1 1

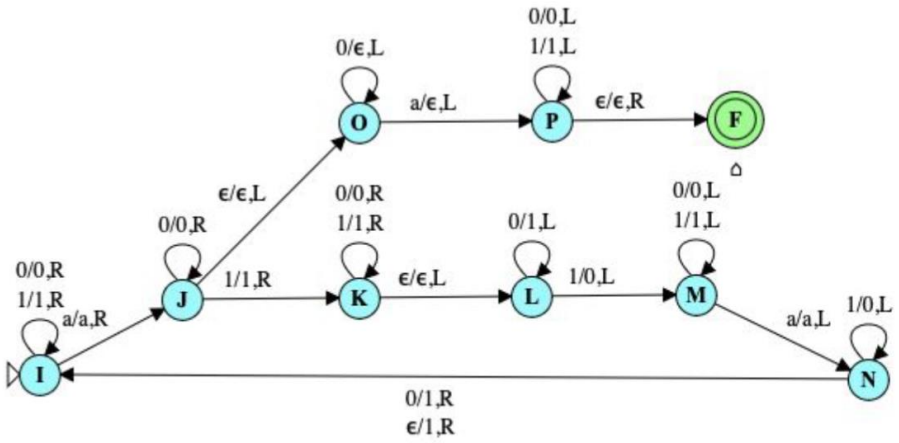
10.) read ‘1’ from tape, write ‘1’ to tape, move tape left, Remain in state (M)

1 | 1 | 0 | 1 | a 1 0 |

11.) read ‘a’ from tape, write ‘a’ to tape, move tape left, Transition from state (M) to (N)

1 | 1 | 0 | 1 a 1 | 0 |

Example: Binary sum of numbers 1101 and 11



12.) Read ‘1’ from tape, write ‘0’ to tape
move tape left, Remain in state (N)

| 1 | 1 | 0 | **1** | a | 1 | 0 |

13.) read ‘0’ from tape, write ‘1’ to tape, move tape right
Transition from state (N) to (I)

| 1 | 1 | **0** | 0 | a | 1 | 0 |

14.) read ‘0’ from tape, write 0 to tape, move tape right,
Remain in state (I)

| 1 | 1 | 1 | **0** | a | 1 | 0 |

15.) read ‘a’ from tape, write ‘a’ to tape, move tape right,
transition from state (I) to (J)

| 1 | 1 | 1 | 0 | **a** | 1 | 0 |

16.) read ‘1’ from tape, write ‘1’ to tape, move tape right
Transition from state (J) to (K)

| 1 | 1 | 1 | 0 | a | **1** | 0 |

17.) read ‘0’ from tape, write ‘0’ to tape, move tape right
Remain in state (K)

| 1 | 1 | 1 | 0 | a | 1 | **0** |

18.) read ‘**ε**’ from tape, write ‘**ε**’ to tape, move tape left,
Transition from state (K) to (L)

| 1 | 1 | 1 | 0 | a | 1 | 0 | **ε** |

19.) read ‘0’ from tape, write ‘1’ to tape, move tape left
Remain in state (L)

| 1 | 1 | 1 | 0 | a | 1 | **0** |

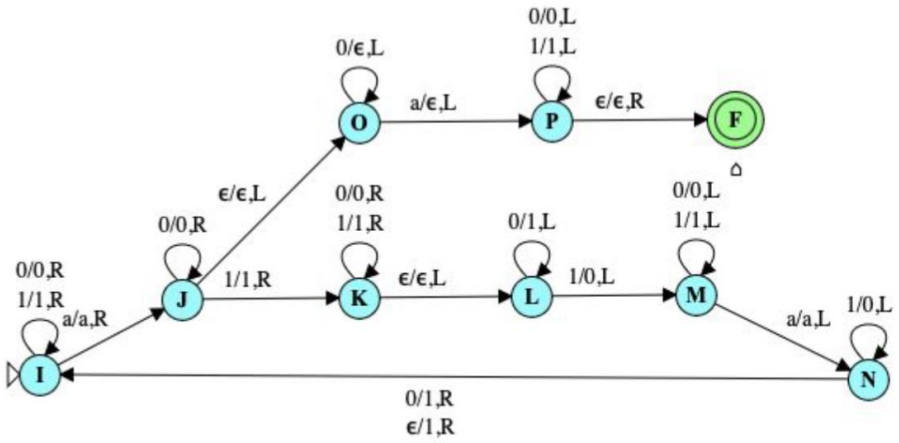
20.) Read ‘1’ from tape, write ‘0’ to tape, move tape left,
Transition from state (L) to (M)

| 1 | 1 | 1 | 0 | a | **1** | 1 |

21.) Read ‘a’ from tape, write ‘a’ to tape, move tape left,
Transition from state (M) to (N)

| 1 | 1 | 1 | 0 | **a** | 0 | 1 |

Example: Binary sum of numbers 1101 and 11



22.) Read ‘0’ from tape, write ‘1’ to tape
move tape right, transition from state (N) to (I)

| 1 | 1 | 1 | 0 | a | 0 | 1 |

23.) Read ‘a’ from tape, write ‘a’ to tape
move tape right, transition from state (I) to (J)

| 1 | 1 | 1 | 1 | a | 0 | 1 |

24.) read ‘0’ from tape, write ‘0’ from tape,
Move tape right, remain in state (J)

| 1 | 1 | 1 | 1 | a | 0 | 1 |

25.) read ‘1’ from tape, write ‘1’ to tape, move tape right
Transition from state (J) to (K)

| 1 | 1 | 1 | 1 | a | 0 | 1 |

26.) read ‘**ε**’ from tape, write ‘**ε**’ to tape, move tape left,
Transition from state (K) to (L)

| 1 | 1 | 1 | 1 | a | 0 | 1 |

27.) read ‘1’ from tape, write ‘0’ to tape, move tape left
Transition from state (L) to (M)

| 1 | 1 | 1 | 1 | a | 0 | 1 |

28.) read ‘0’ from tape, write ‘0’ to tape, move tape left
Remain in state (M)

| 1 | 1 | 1 | 1 | a | 0 | 0 |

29.) Read ‘a’ from tape, write ‘a’ to tape
move tape left, transition from state (M) to (N)

| 1 | 1 | 1 | 1 | a | 0 | 0 |

30.) read ‘1’ from tape, write ‘0’ to tape, move tape left
Remain in state (N)

| 1 | 1 | 1 | 1 | a | 0 | 0 |

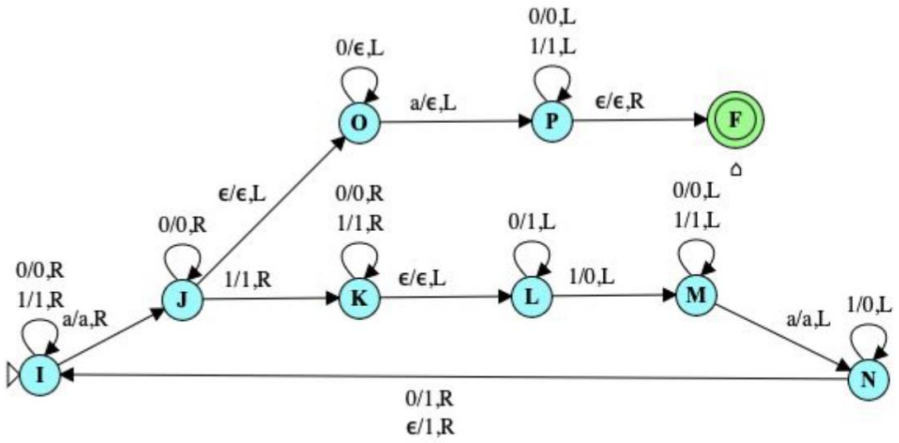
31.) read ‘1’ from tape, write ‘0’ to tape, move tape left
Remain in state (N)

| 1 | 1 | 1 | 0 | a | 0 | 0 |

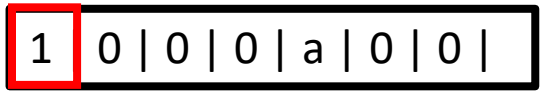
32.) read ‘1’ from tape, write ‘0’ to tape, move tape left
Remain in state (N)

| 1 | 1 | 0 | 0 | a | 0 | 0 |

Example: Binary sum of numbers 1101 and 11



33.) read ‘1’ from tape, write ‘0’ to tape, move tape left
Remain in state (N)



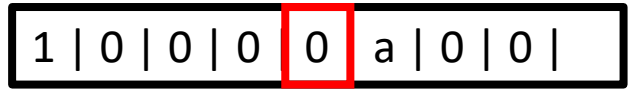
34.) read ‘**ε**’ from tape, write ‘1’ to tape, move tape right
Transition from state (N) to (I)

35.) read ‘**0**’ from tape, write ‘0’ to tape, move tape right
Remain in state (I)

36.) read ‘**0**’ from tape, write ‘0’ to tape, move tape right
Remain in state (I)

37.) read ‘**0**’ from tape, write ‘0’ to tape, move tape right
Remain in state (I)

38.) read ‘**0**’ from tape, write ‘0’ to tape, move tape right
Remain in state (I)



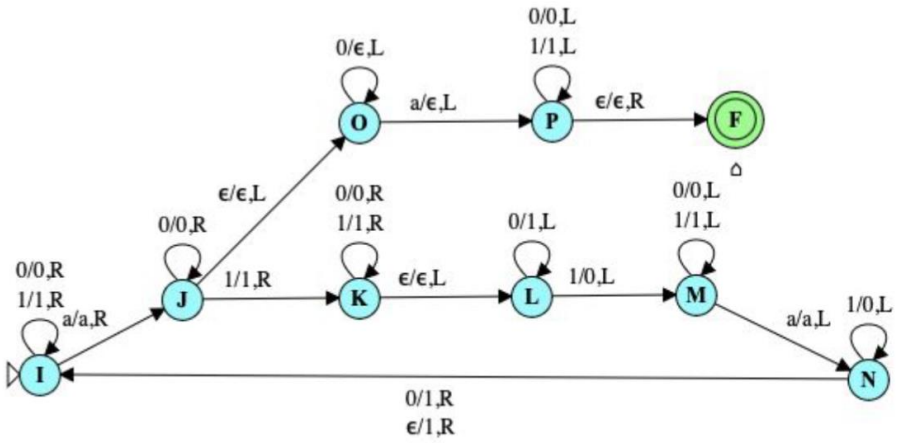
39.) read ‘**a**’ from tape, write ‘a’ to tape, move tape right
Transition from state (I) to (J)

40.) read ‘**0**’ from tape, write ‘0’ to tape, move tape right
Remain in state (J)

41.) read ‘**0**’ from tape, write ‘0’ to tape, move tape right
Remain in state (J)

42.) read ‘**ε**’ from tape, write ‘**ε**’ to tape, move tape left
Transition from state (J) to (O)

Example: Binary sum of numbers 1101 and 11



43.) read '**0**' from tape, write '**ε**' to tape, move tape left
Remain in state (O)

1	0	0	0	0	a	0	0

44.) read '**0**' from tape, write '**ε**' to tape, move tape left
Remain in state (O)

1	0	0	0	0	a	0

45.) read '**a**' from tape, write '**ε**' to tape, move tape left
Transition from state (O) to (P)

1	0	0	0	0	a

46.) read '**0**' from tape, write '**0**' to tape, move tape left
Remain in state (P)

1	0	0	0	0

47.) read '**0**' from tape, write '**0**' to tape, move tape left
Remain in state (P)

1	0	0	0	0

48.) read '**0**' from tape, write '**0**' to tape, move tape left
Remain in state (P)

1	0	0	0	0

49.) read '**0**' from tape, write '**0**' to tape, move tape left
Remain in state (P)

1	0	0	0	0

50.) read '**1**' from tape, write '**1**' to tape, move tape left
Remain in state (P)

1	0	0	0	0

51.) read '**ε**' from tape, write '**ε**' to tape, move tape right
Transition from state (P) to (F)

	1	0	0	0	0

Word is accepted!

	1	0	0	0	0

Tape output is: 10000
13 + 3 = 16