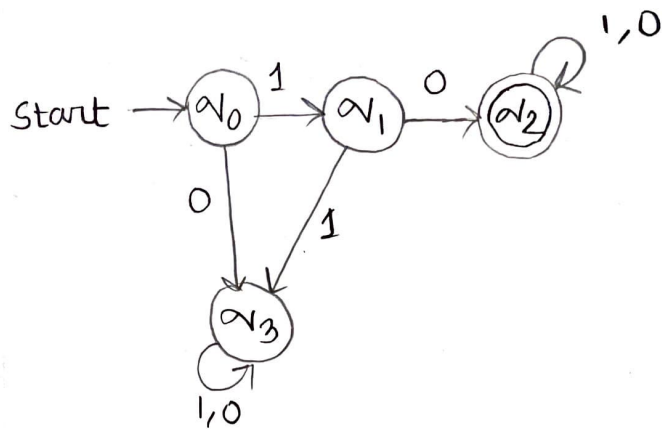# CSE331

## ASSIGNMENT 1

Submitted by: Masiat Hasin Rodoshi
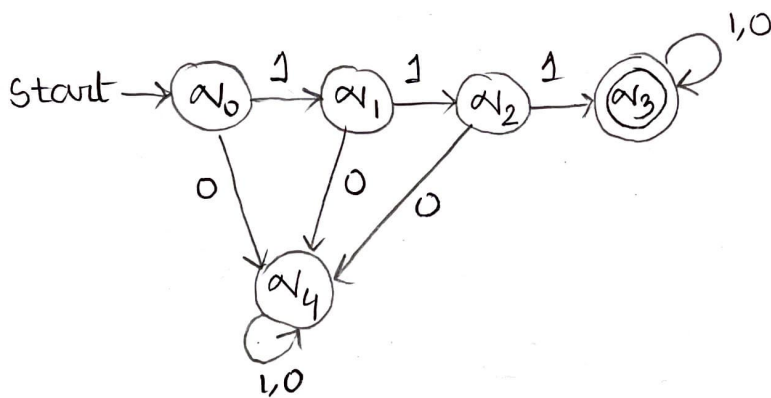ID: 19201089
Section: 1
Date: 11.10.2022
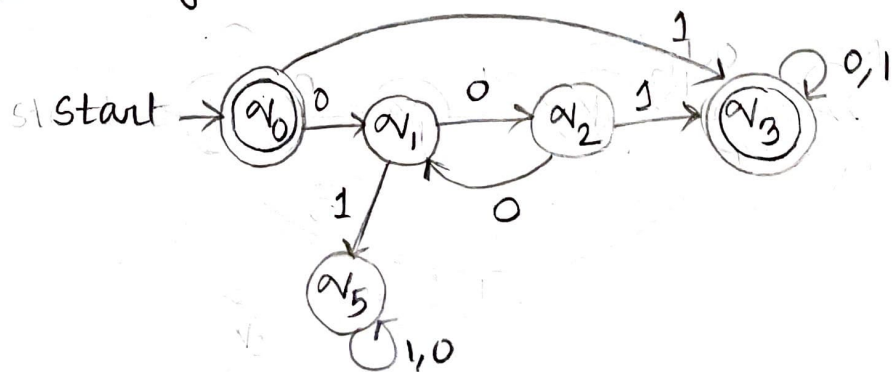
# 1. Strings that start with 10.

Start $\rightarrow$ $N_0$ $\xrightarrow{1}$ $N_1$ $\xrightarrow{0}$ $N_2$ with self-loop labeled $1,0$

$N_0$ $\xrightarrow{0}$ $N_3$

$N_1$ $\xrightarrow{1}$ $N_3$

$N_3$ with self-loop labeled $1,0$

# 2. Strings that start with at least three 1's.

Start $\rightarrow$ $N_0$ $\xrightarrow{1}$ $N_1$ $\xrightarrow{1}$ $N_2$ $\xrightarrow{1}$ $N_3$ with self-loop labeled $1,0$

$N_0$ $\xrightarrow{0}$ $N_4$

$N_1$ $\xrightarrow{0}$ $N_4$

$N_2$ $\xrightarrow{0}$ $N_4$

$N_4$ with self-loop labeled $1,0$

# 3. Strings that start with even number of 0's.

Start $\rightarrow$ $N_0$ $\xrightarrow{0}$ $N_1$ $\xrightarrow{0}$ $N_2$ $\xrightarrow{1}$ $N_3$ with self-loop labeled $0,1$

$N_0$ $\xrightarrow{1}$ $N_3$

$N_2$ $\xrightarrow{0}$ $N_1$

$N_1$ $\xrightarrow{1}$ $N_5$

$N_5$ with self-loop labeled $1,0$

## 4. Strings that contain '10101' as a substring.

Start $\rightarrow$ $N_0$ $\xrightarrow{1}$ $N_1$ $\xrightarrow{0}$ $N_2$ $\xrightarrow{1}$ $N_3$ $\xrightarrow{0}$ $N_4$ $\xrightarrow{1}$ $N_5$

- $N_0$: loop $0$
- $N_1$: loop $1$
- $N_1 \xrightarrow{1} N_2$ (via top arc)
- $N_2 \xrightarrow{0} N_0$ (via bottom arc)
- $N_4 \xrightarrow{0} N_0$ (via bottom arc)
- $N_5$: loop $1,0$
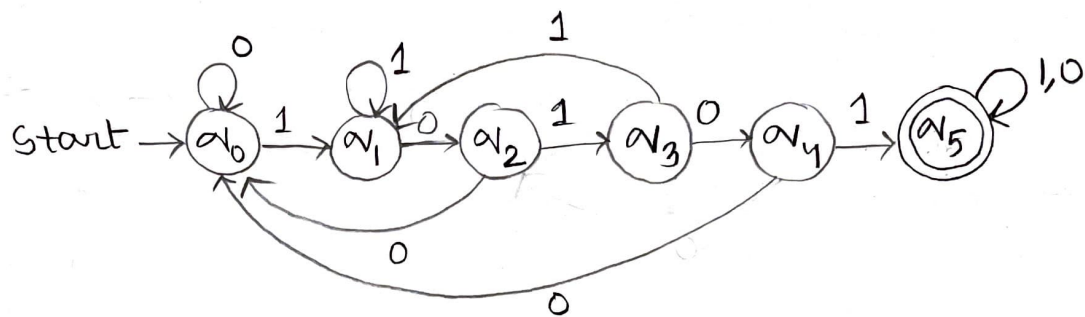
## 5. Strings that do not contain 10101 as a substring

Start $\rightarrow$ $N_0$ $\xrightarrow{1}$ $N_1$ $\xrightarrow{0}$ $N_2$ $\xrightarrow{1}$ $N_3$ $\xrightarrow{0}$ $N_4$ $\rightarrow$ $N_5$

- $N_0$: loop $0$
- $N_1$: loop $1$
- top arc $1$
- $N_2 \xrightarrow{0} N_0$
- $N_4 \xrightarrow{0} N_0$
- $N_5$: loop $1,0$
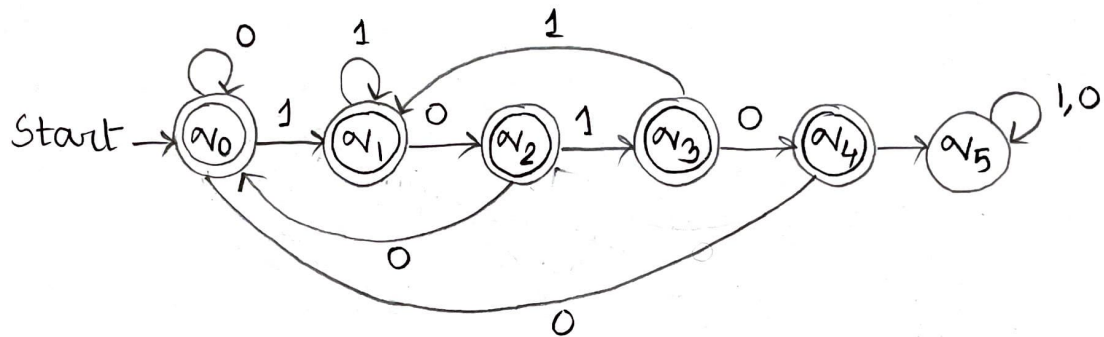
## 6. Strings that have at least two occurances of 100.

Start $\rightarrow$ $N_0$ $\xrightarrow{1}$ $N_1$ $\xrightarrow{0}$ $N_2$ $\xrightarrow{0}$ $N_3$ $\xrightarrow{1}$ $N_4$ $\xrightarrow{0}$ $N_5$ $\xrightarrow{0}$ $N_6$

- $N_0$: loop $0$
- $N_1$: loop $1$
- $N_2 \xrightarrow{1} N_1$
- $N_3$: loop $0$
- $N_4$: loop $1$
- $N_5 \xrightarrow{1} N_4$
- $N_6$: loop $1,0$

## 7. Strings that end with 001.

Start $\rightarrow$ $N_0$ $\xrightarrow{0}$ $N_1$ $\xrightarrow{0}$ $N_2$ $\xrightarrow{1}$ $N_3$

- $N_0$: loop $1$
- $N_2$: loop $0$
- $N_1 \xrightarrow{1} N_0$
- $N_3 \xrightarrow{0} N_1$
- $N_3 \xrightarrow{1} N_0$
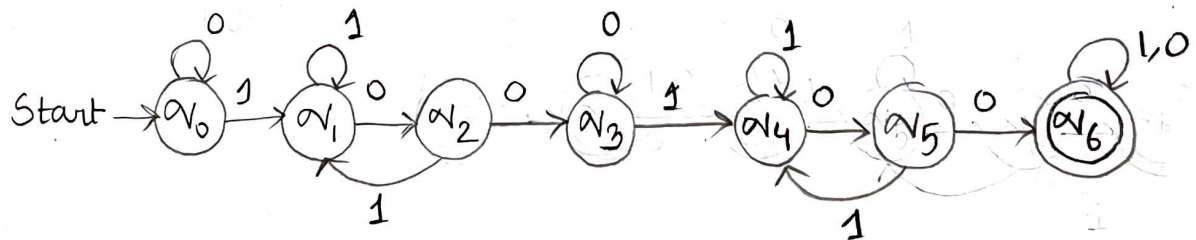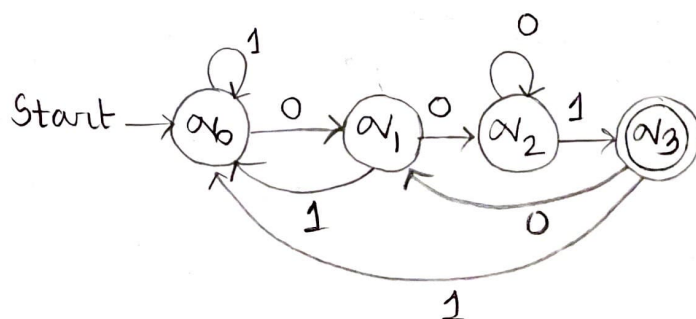
## 8. Strings that end with at most two 0's.

$$
\begin{array}{c}
\text{Start} \rightarrow (\!(N_0)\!) \xrightarrow{0} (\!(N_1)\!) \xrightarrow{0} (\!(N_2)\!) \xrightarrow{0} (N_3)
\end{array}
$$

- $N_0$ has a self-loop labeled $1$
- $N_0 \xrightarrow{1} N_2$
- $N_3$ has a self-loop labeled $0$
- $N_2 \xrightarrow{1} N_0$
- $N_3 \xrightarrow{1} N_0$
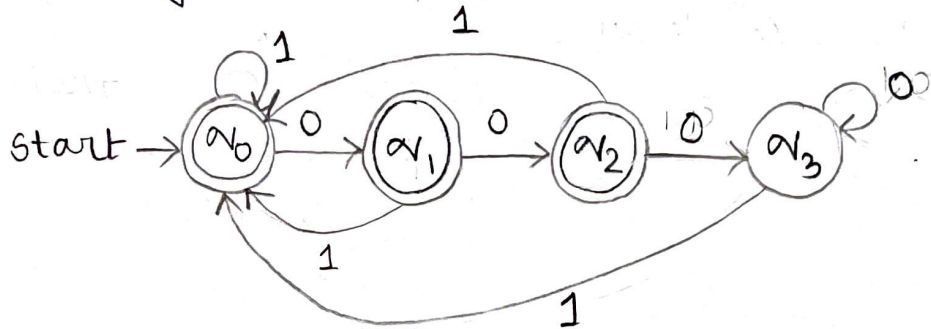
## 9. String that end with odd number of 1's.

$$
\text{Start} \rightarrow (N_0) \xrightarrow{1} (\!(N_1)\!) \xrightarrow{1} (N_2)
$$

- $N_0$ self-loop $0$
- $N_1 \xrightarrow{0} N_0$
- $N_2 \xrightarrow{0} N_0$ (via curved top arrow)
- $N_2 \xrightarrow{1} N_1$
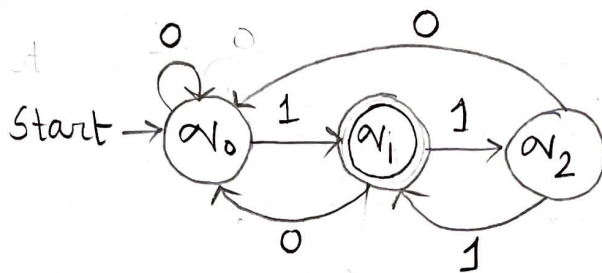
## 10. Strings that have 1011 as subsequence

$$
\text{Start} \rightarrow (N_0) \xrightarrow{1} (N_1) \xrightarrow{0} (N_2) \xrightarrow{1} (N_3) \xrightarrow{1} (\!(N_4)\!)
$$

- $N_0$ self-loop $0$
- $N_1$ self-loop $1$
- $N_2$ self-loop $0$
- $N_3$ self-loop $0$
- $N_4$ self-loop $1,0$
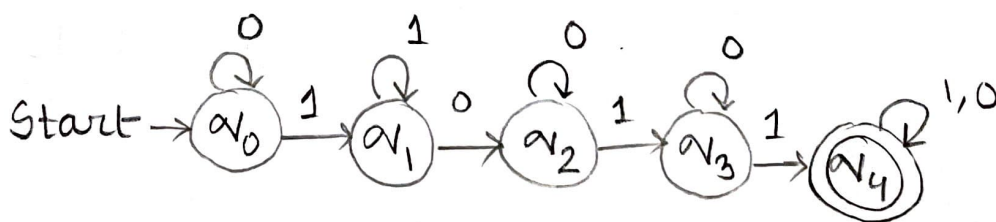
## 11. Strings that don't have 1011 as subsequence.

$$
\text{Start} \rightarrow (\!(N_0)\!) \xrightarrow{1} (\!(N_1)\!) \xrightarrow{0} (\!(N_2)\!) \xrightarrow{1} (\!(N_3)\!) \xrightarrow{1} (N_4)
$$

- $N_0$ self-loop $0$
- $N_1$ self-loop $1$
- $N_2$ self-loop $0$
- $N_3$ self-loop $0$
- $N_4$ self-loop $1,0$

## 12. Binary strings whose decimal equivalent is divisible by 6.

State diagram with states $N_0$ (start), $N_1$, $N_2$, $N_3$, $N_4$, $N_5$.

- $N_0$ self-loop on $0$
- $N_0 \xrightarrow{1} N_1$
- $N_1 \xrightarrow{0} N_2$
- $N_1 \xrightarrow{1} N_3$ (with $0$, $1$ between $N_0$, $N_1$, $N_3$)
- $N_2 \xrightarrow{0} N_4$
- $N_2 \xrightarrow{1} N_5$
- $N_4 \xrightarrow{0} N_2$
- $N_3 \xrightarrow{0} N_0$
- $N_5$ self-loop on $1$
- $N_5 \xrightarrow{0} N_4$
- $N_4 \xrightarrow{1} N_3$
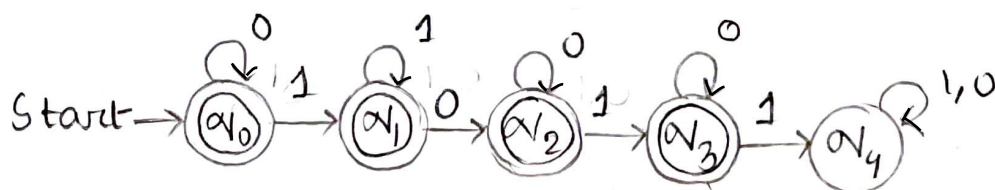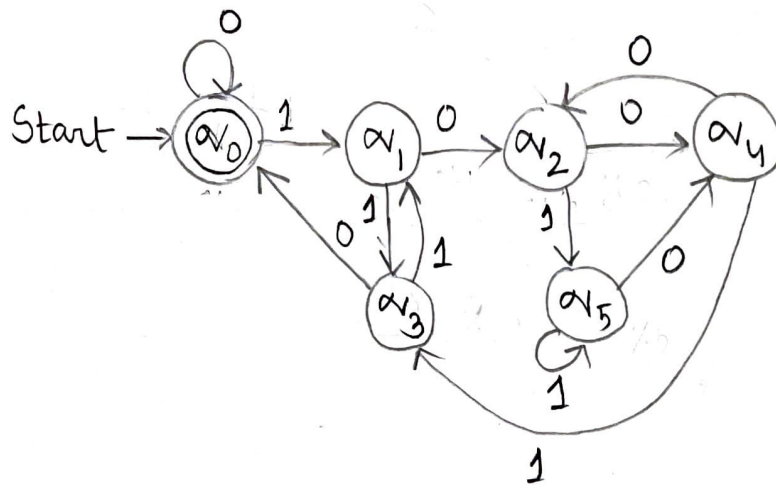
## 13. Binary strings which has 0 at its fourth position

$$Start \to N_0 \xrightarrow{1,0} N_1 \xrightarrow{1,0} N_2 \xrightarrow{1,0} N_3 \xrightarrow{0} N_4 \,(1,0\ loop)$$

$N_3 \xrightarrow{1} N_5$ , $N_5$ self-loop $1,0$
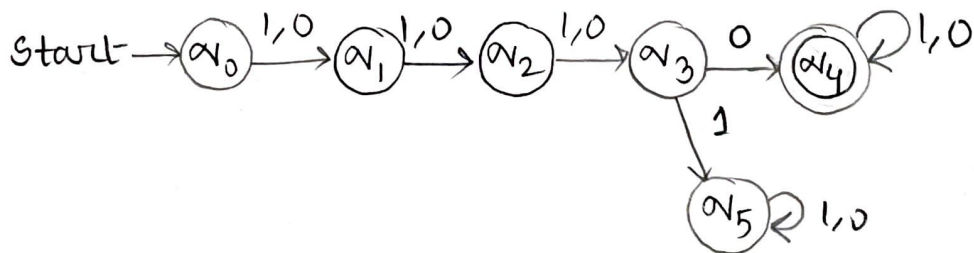
## 14. Binary String which has 1 at its third last position

$$Start \to N_0 \xrightarrow{1} N_1 \xrightarrow{1,0} N_2 \xrightarrow{1,0} N_3$$

$N_0 \xrightarrow{0} N_4$ , $N_4$ self-loop $1,0$

15. Binary strings whose decimal equivalent is divisible by 8.