Unit-6: Model-checking ω-regular properties
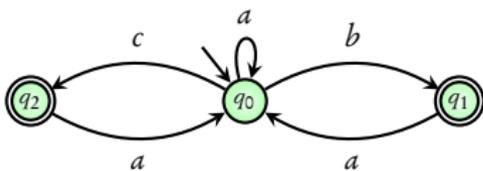
B. Srivathsan

Chennai Mathematical Institute
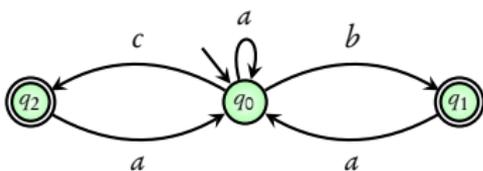
NPTEL-course

July - November 2015

Module 4:
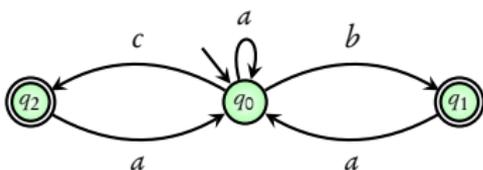
Generalized Büchi Automata

$$(a^*(b+c)a)^\omega$$

Accept states: $\{q_1, q_2\}$

$$(a^*(b+c)a)^\omega$$

Accept states: $\{q_1, q_2\}$

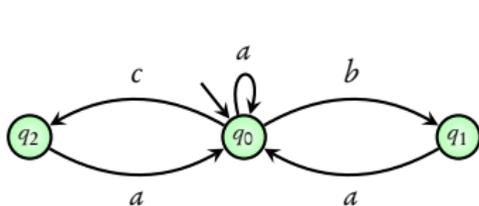Above NBA also accepts *ababababababab*.....

$(a^*(b+c)a)^\omega$

Accept states: $\{q_1, q_2\}$

Above NBA also accepts *abababababababab.....*

Suppose we want NBA for **subset** of $(a^*(b+c)a)^\omega$ where
both b and c occur infinitely often

$$(a^*(b+c)a)^\omega$$
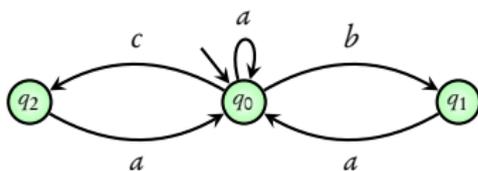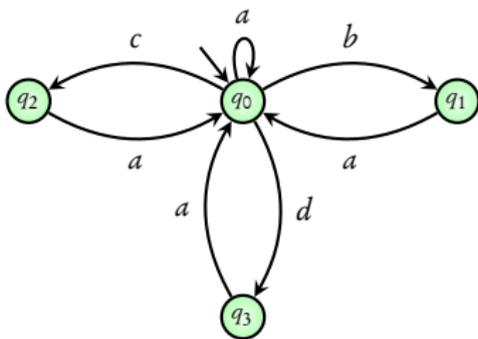
~~Accept states: $\{q_1, q_2\}$~~

Above NBA also accepts *ababababababab*.....

Suppose we want NBA for **subset** of $(a^*(b+c)a)^\omega$ where
both b and c occur infinitely often

Modified accepting condition: $\{ \{q_1\}, \{q_2\} \}$

$(a^*(b+c)a)^\omega$

~~Accept states:~~ $\{q_1, q_2\}$

Above NBA also accepts *ababababababab*.....

Suppose we want NBA for **subset** of $(a^*(b+c)a)^\omega$ where
both b and c occur infinitely often

Modified accepting condition: $\{\ \{q_1\}, \{q_2\}\ \}$

Get GNBA for subset of $(a^*(b+c+d)a)^\omega$ where:

d occurs infinitely often **and**

either b **or** c occur infinitely often
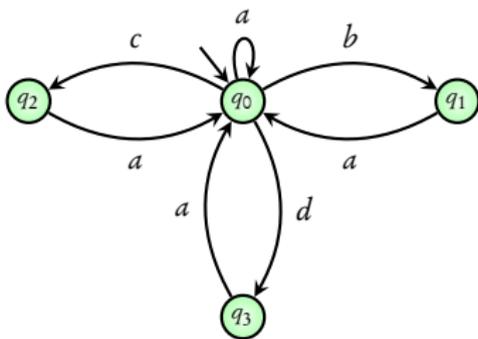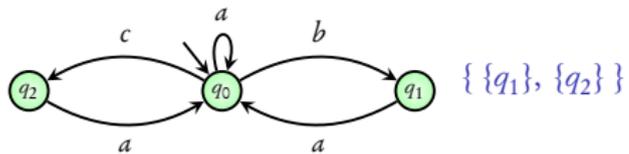
Get GNBA for subset of $(a^*(b+c+d)a)^\omega$ where:

d occurs infinitely often **and**

either b **or** c occur infinitely often
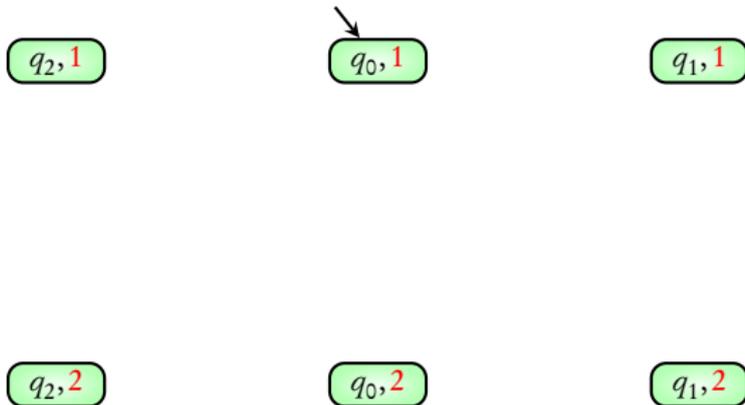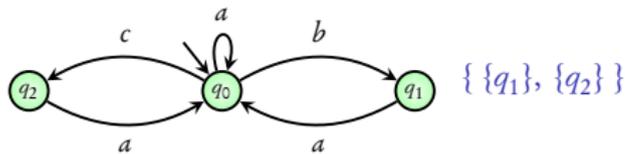
Accepting condition: $\{ \{q_3\}, \{q_1, q_2\} \}$

Generalized Büchi Automata

- States, transitions, initial states as in an NBA

- Accepting condition: $\{ F_1, F_2, \ldots, F_k \}$

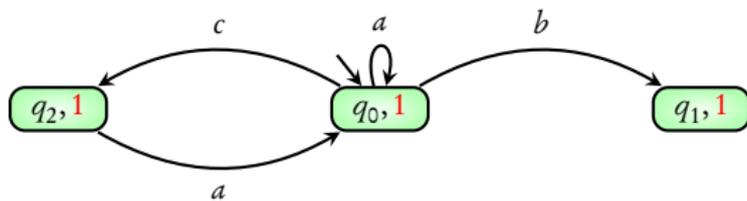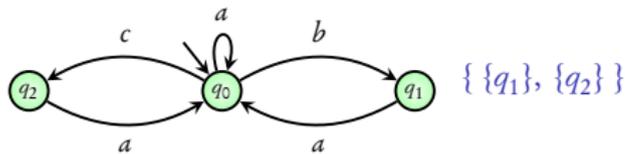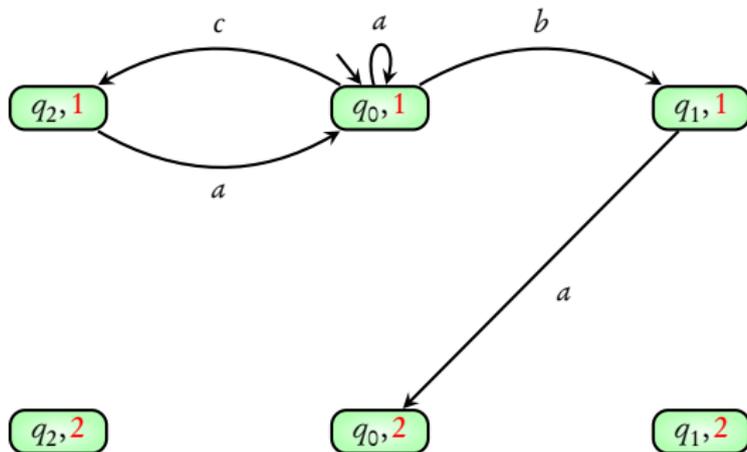- Run is accepting if **some state from each of the F_i occurs infinitely often**

GNBA

$\{ \{q_1\}, \{q_2\} \}$

GNBA

$\{\{q_1\}, \{q_2\}\}$

$q_2, 1$ $q_0, 1$ $q_1, 1$

$q_2, 2$ $q_0, 2$ $q_1, 2$

GNBA

$\{ \{q_1\}, \{q_2\} \}$

GNBA

$\{ \{q_1\}, \{q_2\} \}$

GNBA

$\{\{q_1\}, \{q_2\}\}$

GNBA

$\{\{q_1\}, \{q_2\}\}$

GNBA

q_2 c a b q_0 q_1 a a

$\{\{q_1\}, \{q_2\}\}$

$q_2, 1$ c a b $q_0, 1$ $q_1, 1$

a a

a

$q_2, 2$ c a b $q_0, 2$ $q_1, 2$

a

GNBA

q_2 q_0 q_1
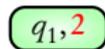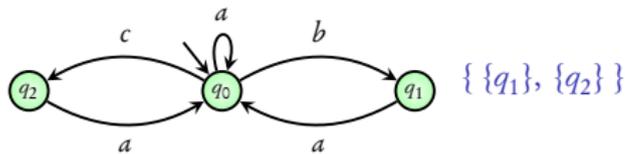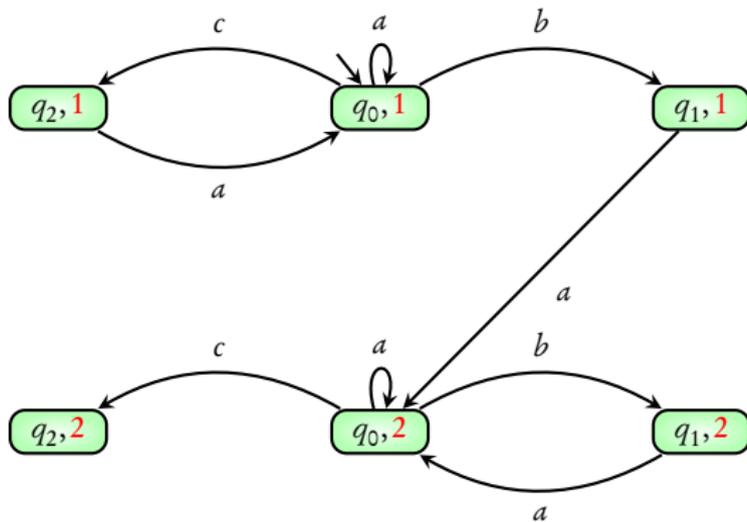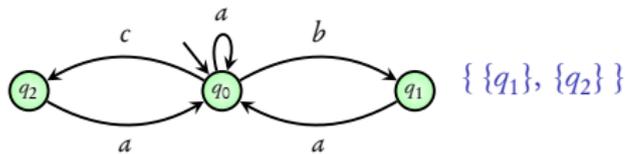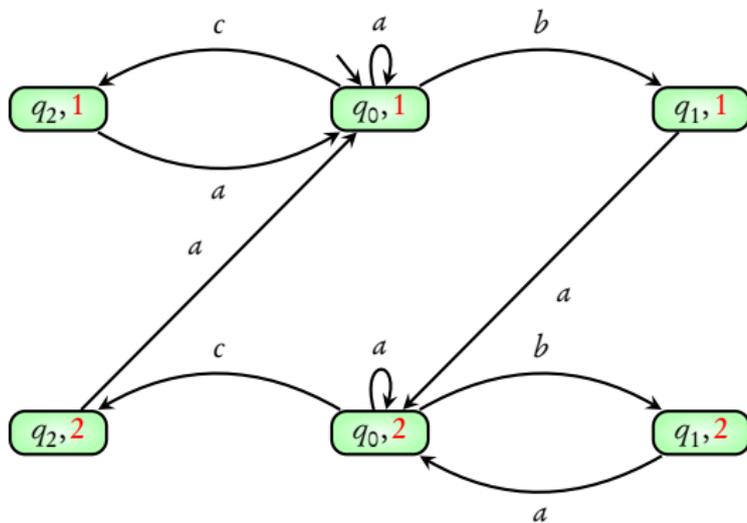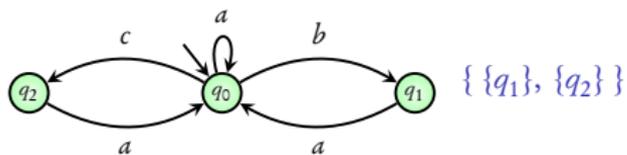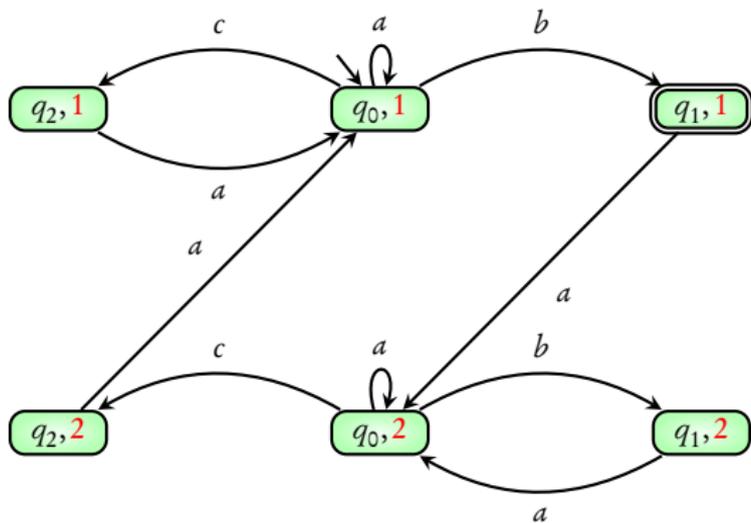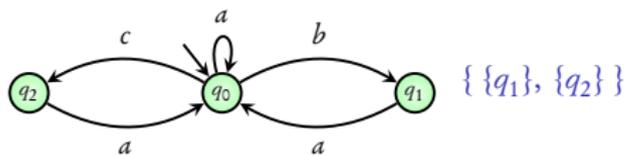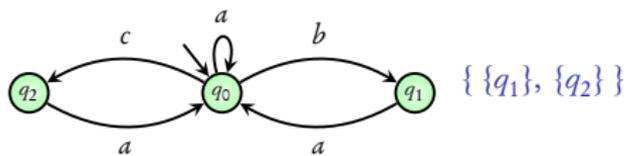
$\{\{q_1\}, \{q_2\}\}$
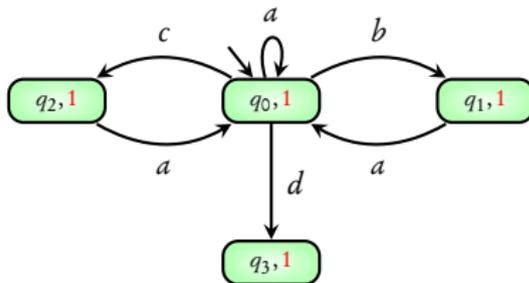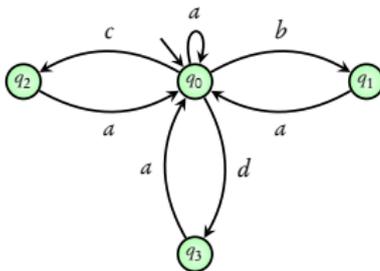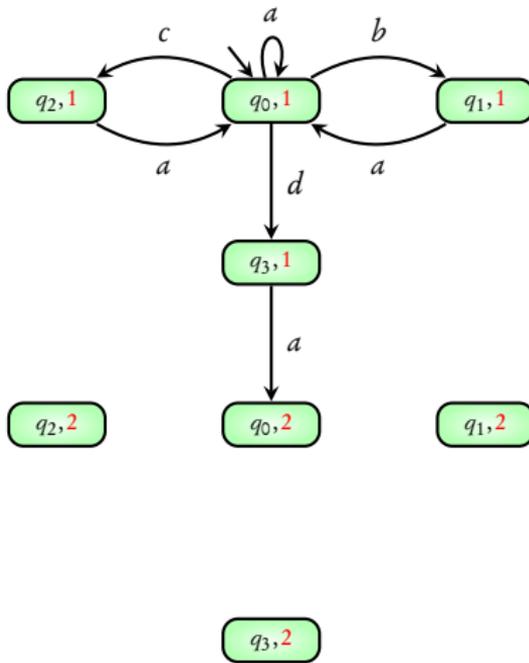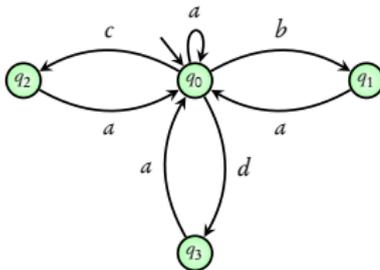
NBA
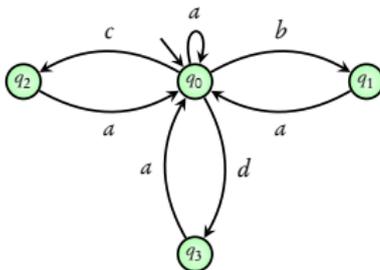
GNBA
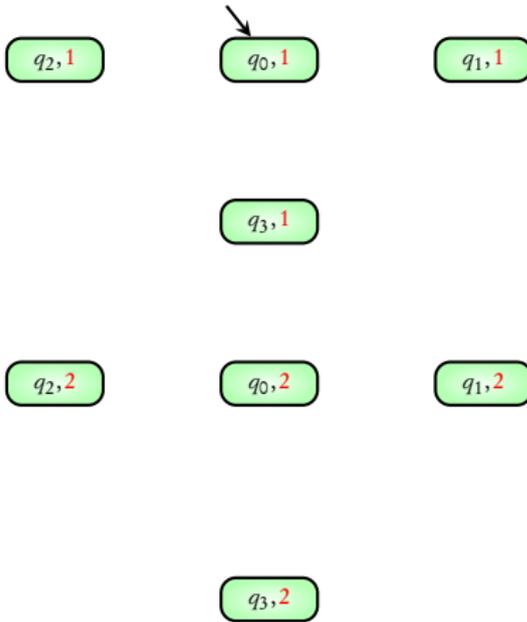
$\{\{q_3\}, \{q_1, q_2\}\}$
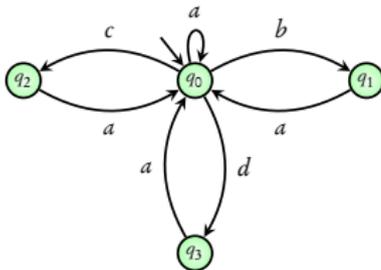
GNBA
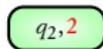
$\{\{q_3\}, \{q_1, q_2\}\}$

GNBA

$\{ \{q_3\}, \{q_1, q_2\} \}$

GNBA
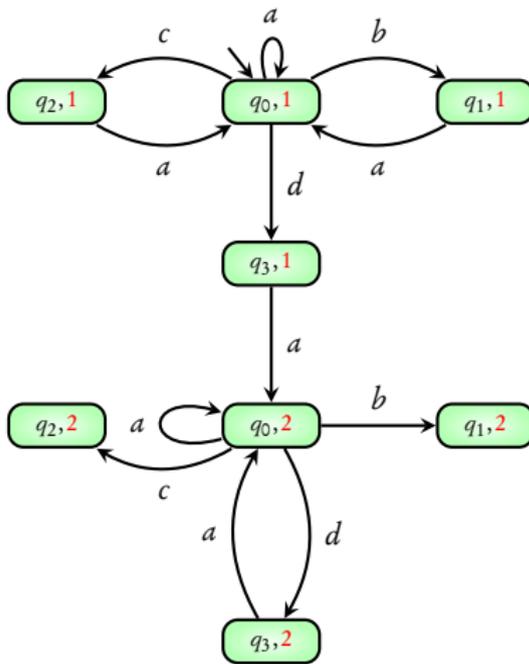
$\{\, \{q_3\},\ \{q_1, q_2\}\,\}$
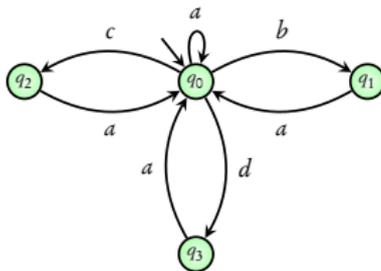
GNBA
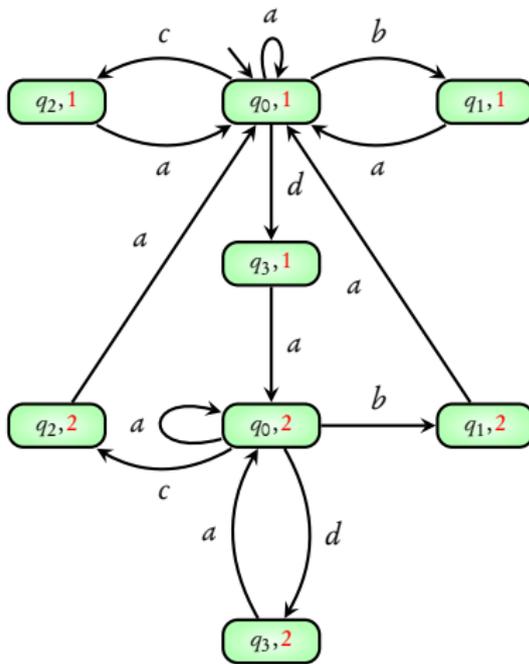
$\{\{q_3\},\{q_1,q_2\}\}$
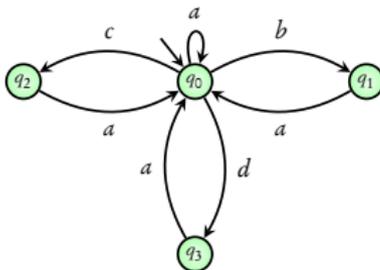
GNBA
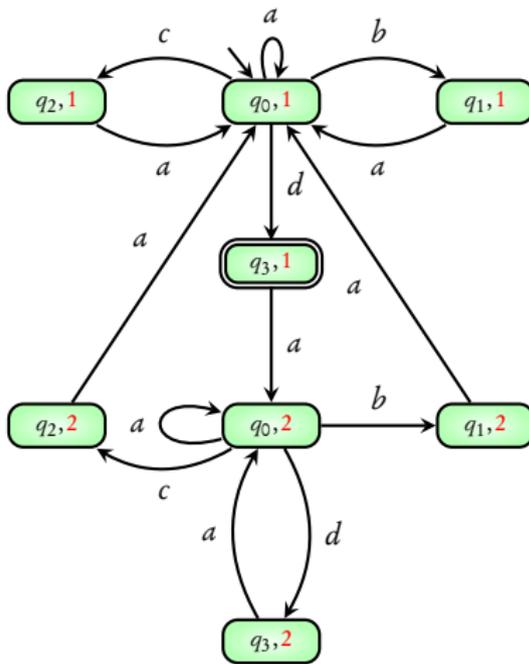
$\{\,\{q_3\}, \{q_1, q_2\}\,\}$

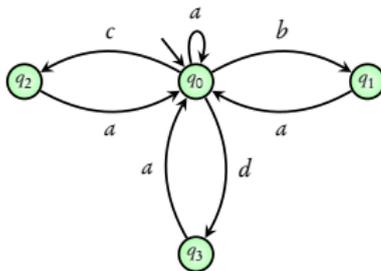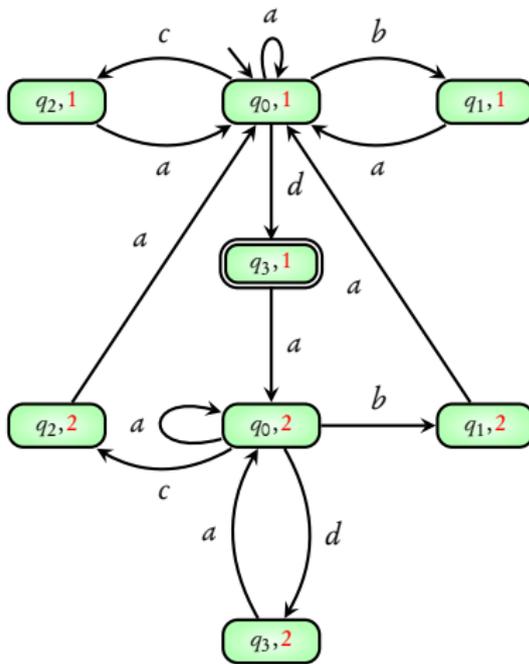**GNBA**

$\{ \{q_3\}, \{q_1, q_2\} \}$

GNBA

$\{\{q_3\}, \{q_1, q_2\}\}$

NBA

Generalized Büchi Automata

- States, transitions, initial states as in an NBA

- Accepting condition: $\{ F_1, F_2, \ldots, F_k \}$

- Run is accepting if **some state from each of the F_i occurs infinitely often**

Every GNBA can be **converted** to an **equivalent NBA**