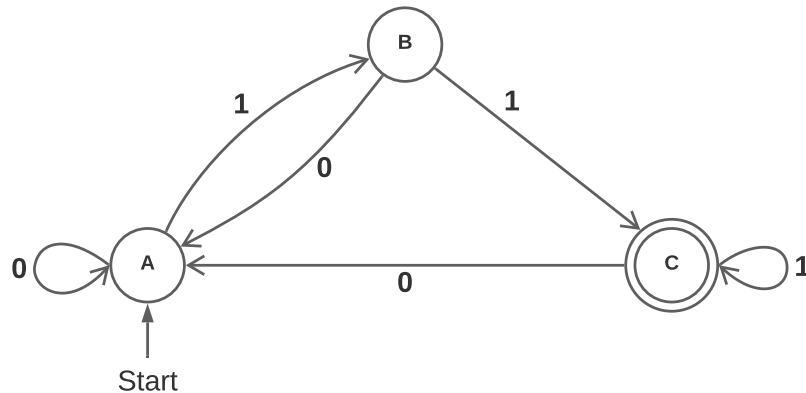


## Module 21: Deterministic Finite State Machine

- 1 Describe a feature of an input string that will allow it to be accepted by the finite state machine described in the diagram below.



**Solution:** Any input string with last two characters "11" will be accepted by the FSM.

Accepting states are first introduced in Lesson 6.8. It is helpful to distinguish between current state after an input string is processed and determining if an input string is accepted by a FSM.

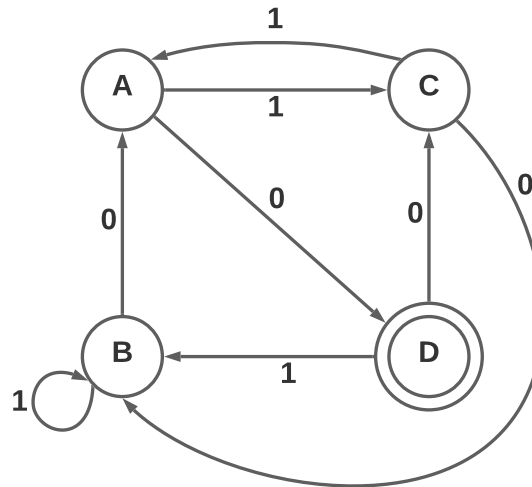
- 2 Below is a transition table for a FSM with states  $\{A, B, C, D\}$ , alphabet  $\{0, 1\}$ , and starting state A. What is the current state after the input string "0011 0011" has processed?

	0	1
A	D	B
B	B	C
C	B	A
D	C	A

**Solution:** A

State transition tables are discussed in Lessons 6.6 and 6.7.

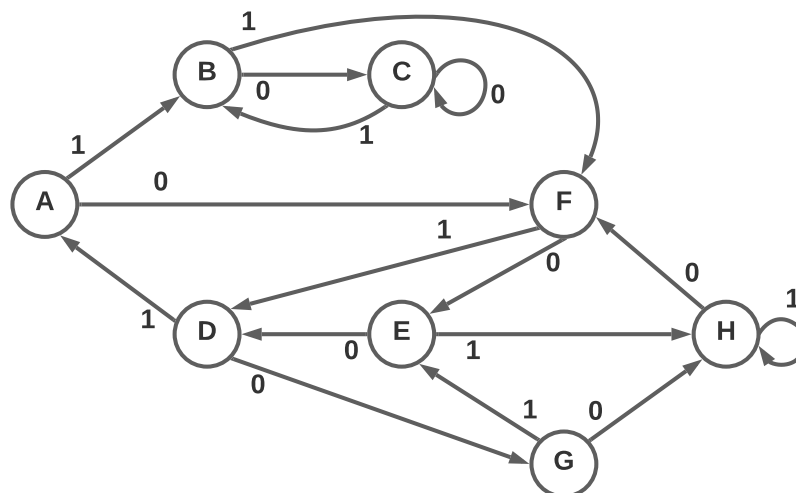
- 3 Which of the following inputs will be accepted by the FSM starting in state A?



- a. 101010
- b. 010101
- c. 011010
- d. 110101
- e. 010110

**Solution:** e

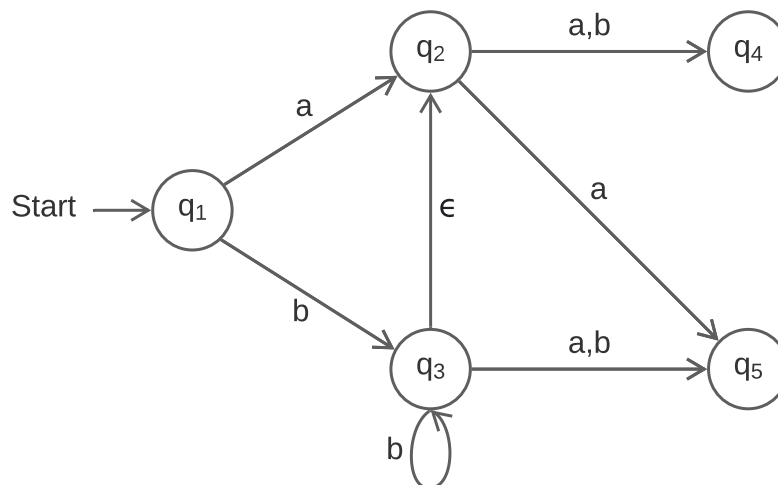
- 4 What state is the automaton in after processing the string 1101 0110 1001 0011 starting from state A?



**Solution:** H

## Module 22: Nondeterministic Finite State Machine

- 5 For each input string below, determine the set of final states when processed by the following NFA.



a) aa

**Solution:**  $\{q_4, q_5\}$

Nondeterministic finite state machines are found in Module 22, Lessons 6.9 - 6.14. After processing the first a, the NFA is in state  $q_2$ . The second a transitions to either  $q_4$  or  $q_5$ .

b) aaa

**Solution:**  $\emptyset$

After processing aa (see part a), the set of possible states is  $\{q_4, q_5\}$ . There are no outgoing edges labeled "a" from these states, so the set of final states after processing the third a is empty.

c) bb

**Solution:**  $\{q_2, q_3, q_4, q_5\}$

Processing just the first b transitions the NFA to  $q_3$ . Because of the epsilon transition, the set of current states after b is  $\{q_2, q_3\}$ . Processing the second b:  $q_2$  transitions to  $q_4$ ,  $q_3$  transitions to  $q_3$  or  $q_5$  but  $q_3$  has the epsilon transition and the NFA could be in state  $q_2$ . Pulling it all together, after bb the NFA could be in  $q_2$ ,  $q_3$ ,  $q_4$ , or  $q_5$ .

d) bba

**Solution:**  $\{q_4, q_5\}$

After processing bb (see part c), the set of possible states is  $\{q_2, q_3, q_4, q_5\}$ . From these, we process the a:  $q_2$  transitions to  $q_4$ ,  $q_3$  transitions to  $q_5$ , and both  $q_4$  and  $q_5$

do not have outgoing edges labeled a. So the set of final states is  $\{q_4, q_5\}$ .

- 6 Below is the transition table for a NFA with states  $\{s_1, s_2, s_3\}$ , alphabet  $\{0, 1\}$ , and starting state  $s_1$ . Determine the set of final states given each input string.

	0	1
$s_1$	$s_2$	$s_1, s_2$
$s_2$	$s_2$	$s_3$
$s_3$	$s_3$	$s_3$

- a. 1

**Solution:**  $\{s_1, s_2\}$

- b. 11

**Solution:**  $\{s_1, s_2, s_3\}$

- c. 111

**Solution:**  $\{s_1, s_2, s_3\}$

- d. 01

**Solution:**  $\{s_3\}$

- e. 1011

**Solution:**  $\{s_3\}$