

# CSE 311: Foundations of Computing

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Fall 2014

Lecture 22: Finite State Machines with Output

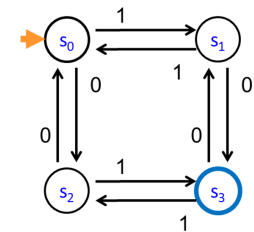
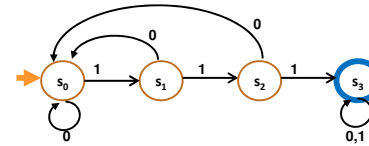


# FSM highlights

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## Finite state machines

- States, transitions, start state, final states
- Languages recognized by FSMs



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FSM that accepts strings of a's, b's, c's with no more than 3 a's

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FSM that accepts binary strings with a 1 three positions from the start

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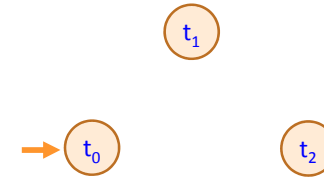
FSM that accepts binary strings with a 1 three positions from the end

Strings over  $\{0, 1, 2\}^*$

**$M_1$ : Strings with an even number of 2's**



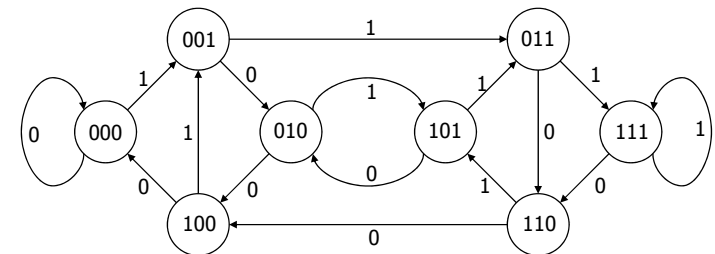
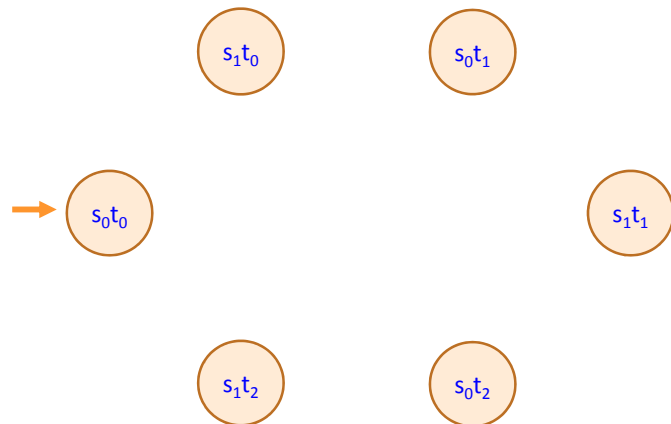
**$M_2$ : Strings where the sum of digits mod 3 is 0**

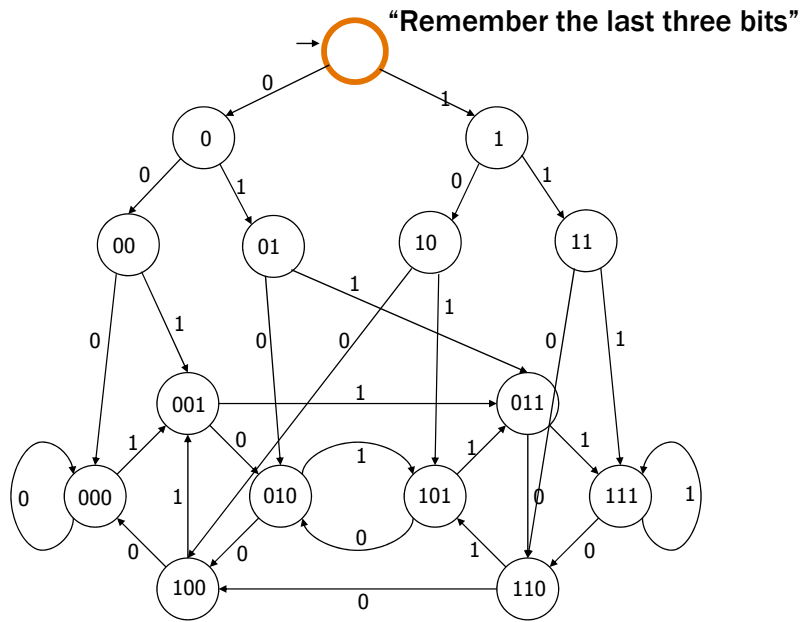


Strings with an even number of 2's and a mod 3 sum of 0

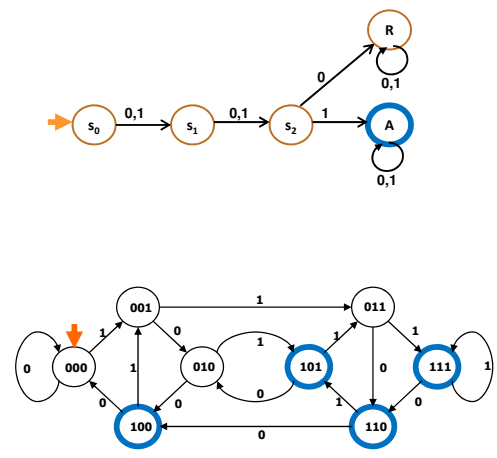
3 bit shift register

“Remember the last three bits”





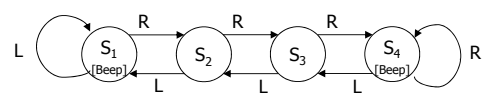
## The beginning versus the end



## State Machines with Output

"Tug-of-war"

State	Input		Output
	L	R	
s <sub>1</sub>	s <sub>1</sub>	s <sub>2</sub>	Beep
s <sub>2</sub>	s <sub>1</sub>	s <sub>3</sub>	
s <sub>3</sub>	s <sub>2</sub>	s <sub>4</sub>	
s <sub>4</sub>	s <sub>3</sub>	s <sub>4</sub>	Beep



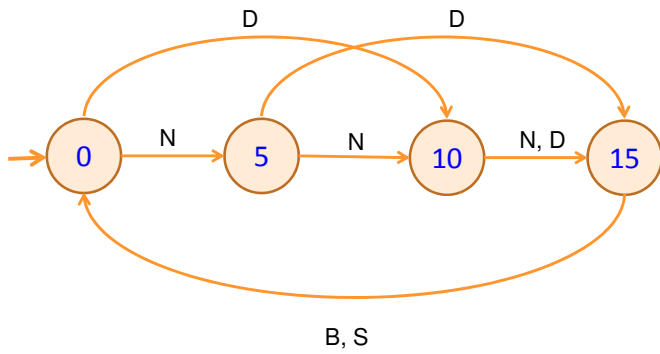
Vending Machine



Enter 15 cents in dimes or nickels  
Press S or B for a candy bar

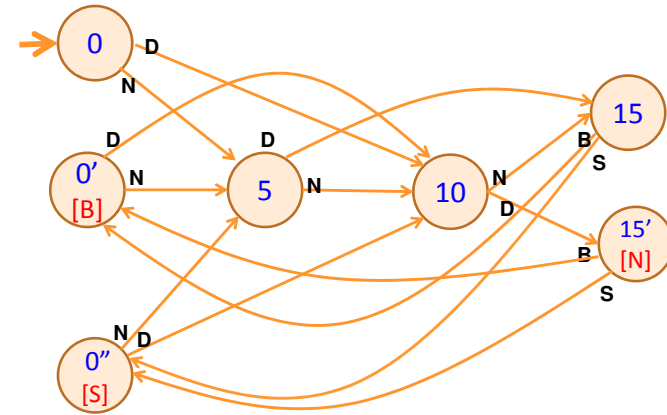


## Vending Machine, v0.1



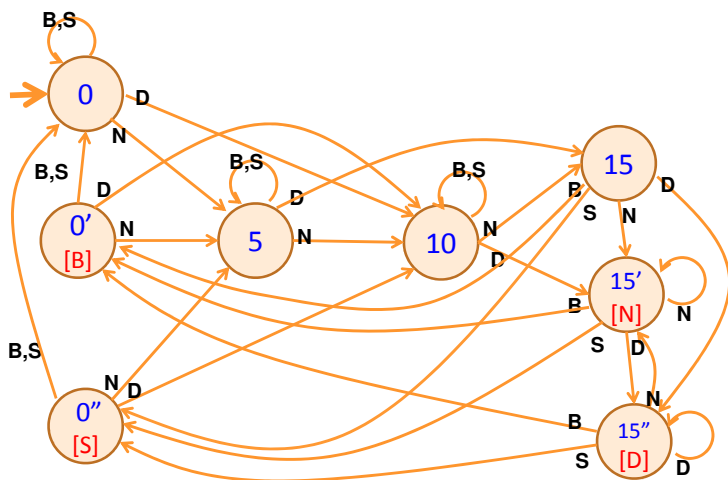
Basic transitions on N (nickel), D (dime), B (butterfinger), S (snickers)

## Vending Machine, v0.2



Adding output to states: N – Nickel, S – Snickers, B – Butterfinger

## Vending Machine, v1.0



Adding additional “unexpected” transitions