CSE 460: VLSI Design (Lab)

Experiment 3, Part 2:

Sequential Circuits Real-life Projects

Vending Machine

What is Vending Machine?

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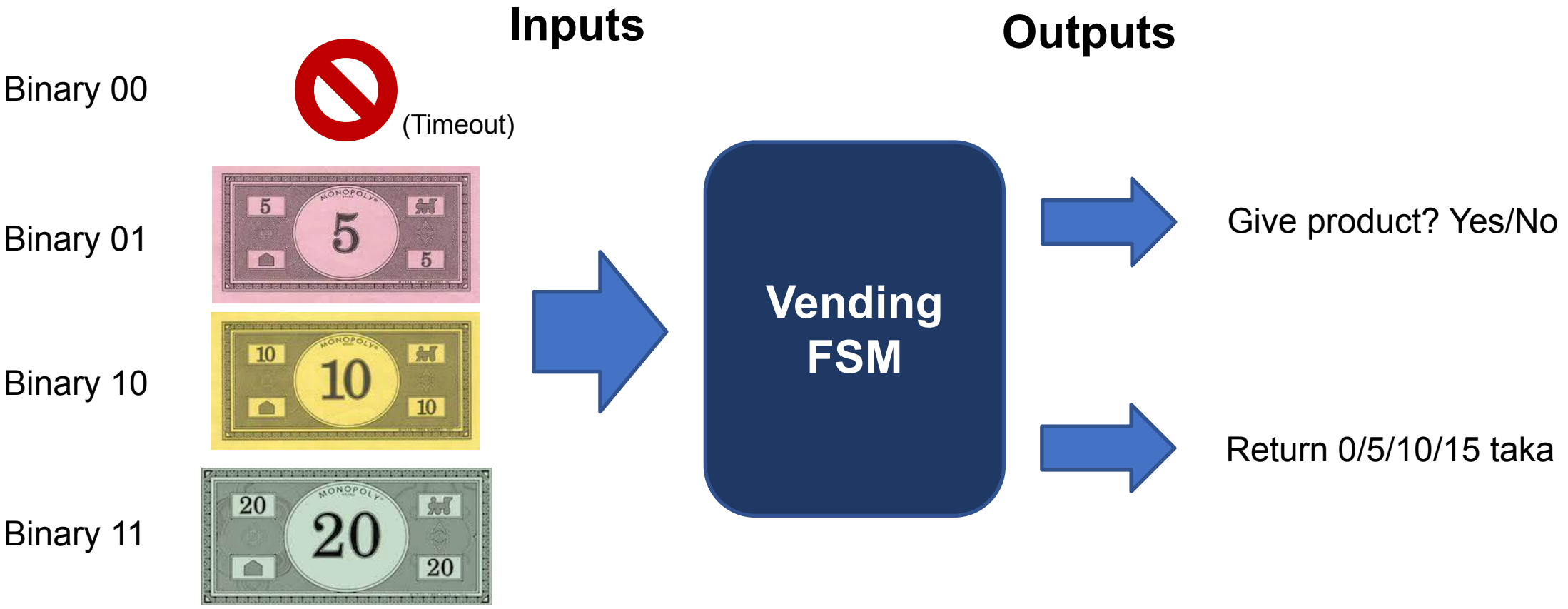
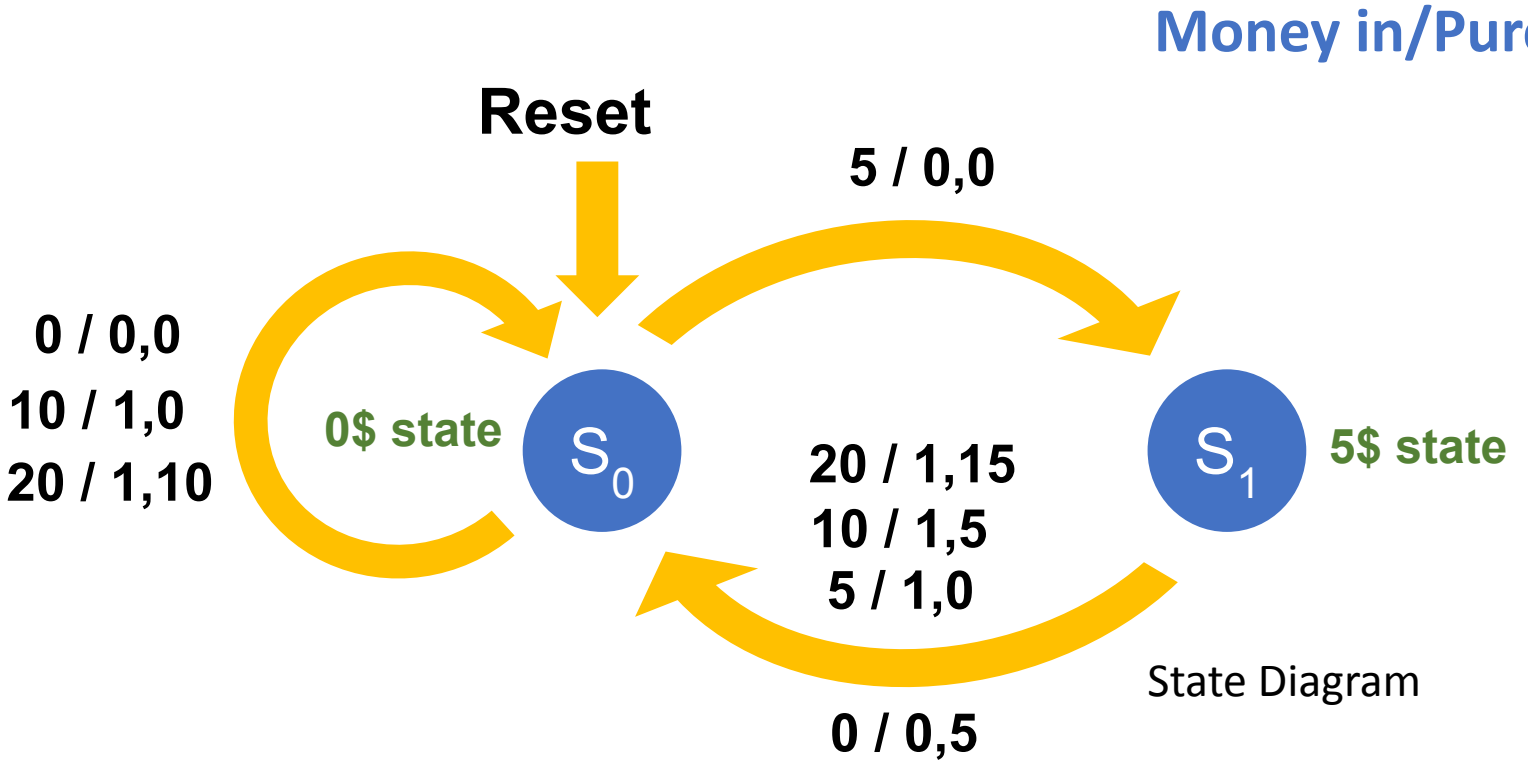
What is Vending Machine?

What is Vending Machine?

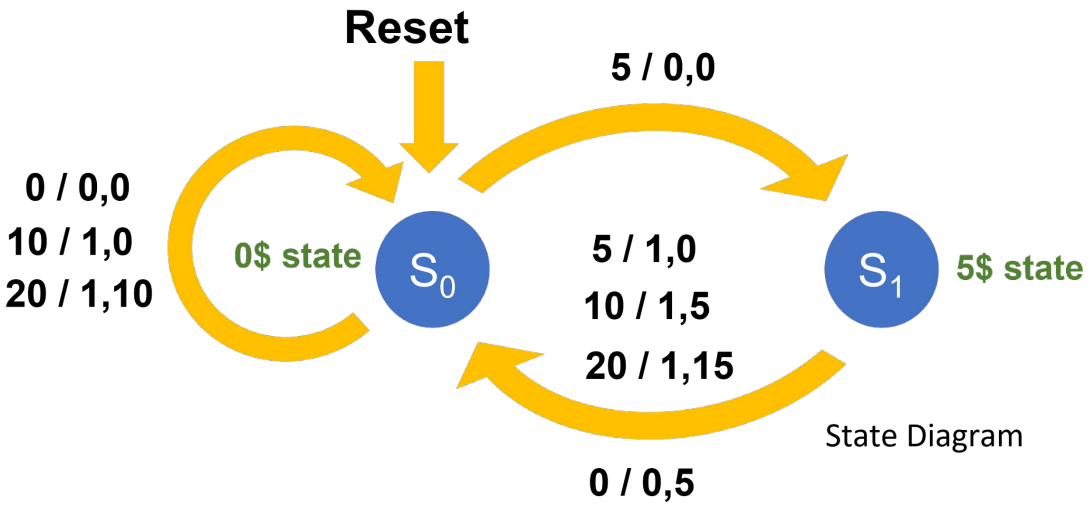
Application Description



10 Tk Product Case (State Diagram)



10 Tk Product Case (State Table)



State Diagram

Present State	Next State				Output							
	Y_2Y_1				z				c_2c_1			
(y_2y_1)	(w_2w_1)				(w_2w_1)				$c(w_2w_1)$			
	00	01	10	11	00	01	10	11	00	01	10	11
S0	**S0**	**S1**	**S0**	**S0**	**0**	**0**	**1**	**1**	**00**	**00**	**00**	**10**
S1	S0	S0	S0	S0	0	1	1	1	01	00	01	11

State Table

Present State	Next State				Output							
	Y_2Y_1				z				c_2c_1			
(y_2y_1)	(w_2w_1)				(w_2w_1)				$c(w_2w_1)$			
	00	01	10	11	00	01	10	11	00	01	10	11
00	**00**	**01**	**00**	**00**	**0**	**0**	**1**	**1**	**00**	**00**	**00**	**10**
01	00	00	00	00	0	1	1	1	01	00	01	11

State Assigned Table

10 Tk Product Case (Code Snippet)

Present State	Next State				Output							
	Y_2Y_1				z				c_2c_1			
(y_2y_1)	(w_2w_1)				(w_2w_1)				$c(w_2w_1)$			
	00	01	10	11	00	01	10	11	00	01	10	11
00	**00**	**01**	**00**	**00**	**0**	**0**	**1**	**1**	**00**	**00**	**00**	**10**
01	00	00	00	00	0	1	1	1	01	00	01	11

State Assigned Table

```
state0: if(cash_in == 2'b00)
            begin
                next_state = state0;
                purchase =0;
                cash_return =0;
            end
        else if(cash_in == 2'b01)
            begin
                next_state=state1;
                purchase = 0;
                cash_return = 0;
            end
        else if(cash_in == 2'b10)
            begin
                next_state=state0;
                purchase=1;
                cash_return=0;
            end
        else if(cash_in == 2'b11)
            begin
                next_state = state0;
                purchase = 1;
                cash_return = 2'b10;
            end
```

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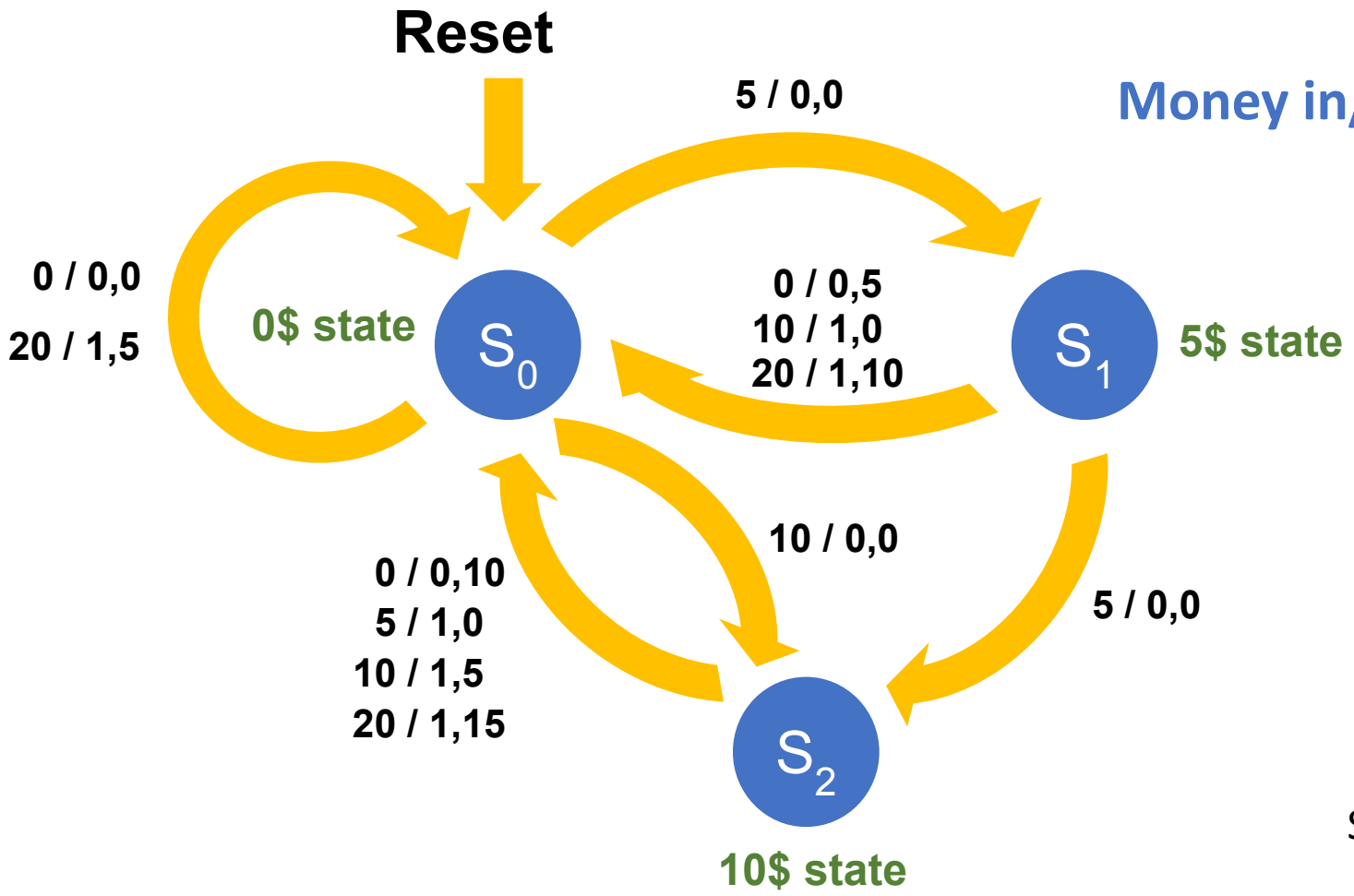
10 Tk Product Case (Code Snippet)

Present State	Next State				Output							
	Y_2Y_1				z				c_2c_1			
(y_2y_1)	(w_2w_1)				(w_2w_1)				$c(w_2w_1)$			
	00	01	10	11	00	01	10	11	00	01	10	11
00	00	01	00	00	0	0	1	1	00	00	00	10
01	00	00	00	00	0	1	1	1	01	00	01	11

State Assigned Table

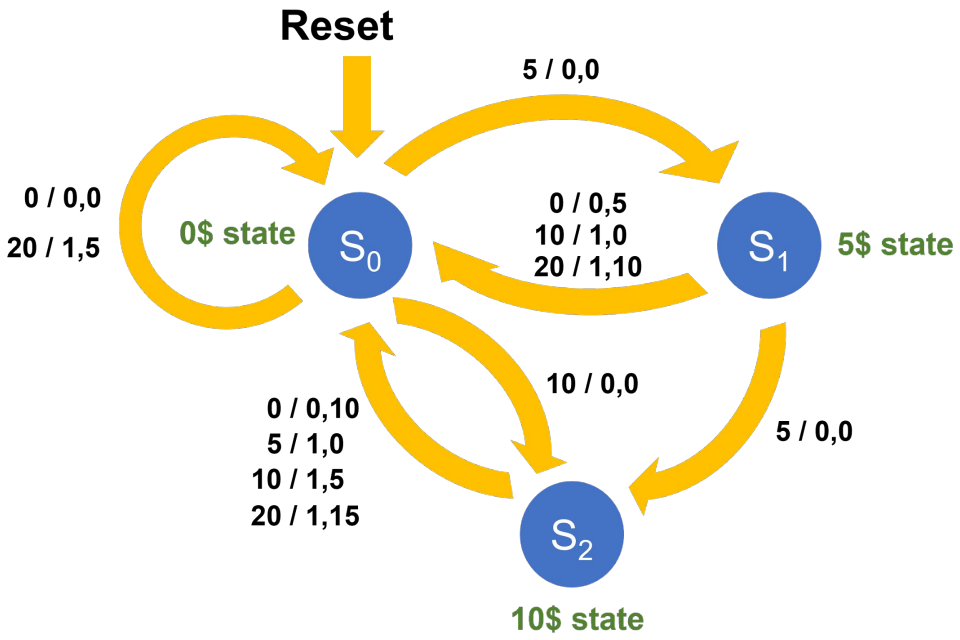
```
        state1: if (cash_in == 2'b00)
                    begin
                        next_state = state0;
                        purchase = 0;
                        cash_return = 2'b01;
                    end
                    else if (cash_in ==2'b01)
                    begin
                        next_state = state0;
                        purchase = 1;
                        cash_return = 0;
                    end
                    else if (cash_in ==2'b10)
                    begin
                        next_state = state0;
                        purchase = 1;
                        cash_return = 2'b01;
                    end
                    else if (cash_in ==2'b11)
                    begin
                        next_state = state0;
                        purchase = 1;
                        cash_return = 2'b11;
                    end

    endcase

    always @(posedge rst, posedge clk)
    if (rst == 1)
        current_state <= state0;
    else
        current_state <= next_state;

endmodule
```

15 Tk Product Case (State Diagram)



State Diagram

15 Tk Product Case (State Table)



Present State	Next State				Output							
	Y_2Y_1				z				c_2c_1			
(y_2y_1)	(w_2w_1)				(w_2w_1)				$c(w_2w_1)$			
	00	01	10	11	00	01	10	11	00	01	10	11
S_0	S_0	S_1	S_2	S_0	0	0	0	1	00	00	00	01
S_1	S_0	S_2	S_0	S_0	0	0	1	1	01	00	00	10
S_2	S_0	S_0	S_0	S_0	0	1	1	1	10	00	01	11

State Table

15 Tk Product Case (State Assigned Table)

Present State	Next State				Output							
	Y_2Y_1				z				c_2c_1			
(y_2y_1)	(w_2w_1)				(w_2w_1)				$c(w_2w_1)$			
	00	01	10	11	00	01	10	11	00	01	10	11
S_0	S_0	S_1	S_2	S_0	0	0	0	1	00	00	00	01
S_1	S_0	S_2	S_0	S_0	0	0	1	1	01	00	00	10
S_2	S_0	S_0	S_0	S_0	0	1	1	1	10	00	01	11

State Table

Present State	Next State				Output							
	Y_2Y_1				z				c_2c_1			
(y_2y_1)	(w_2w_1)				(w_2w_1)				(w_2w_1)			
	00	01	10	11	00	01	10	11	00	01	10	11
00	00	01	10	00	0	0	0	1	00	00	00	01
01	00	10	00	00	0	0	1	1	01	00	00	10
10	00	00	00	00	0	1	1	1	10	00	01	11
11	d	d	d	d	d	d	d	d	d	d	d	d

State Assigned Table

15 Tk Product Case (Code Snippet)

Present State	Next State				Output							
	Y_2Y_1				z				c_2c_1			
(y_2y_1)	(w_2w_1)				(w_2w_1)				(w_2w_1)			
	00	01	10	11	00	01	10	11	00	01	10	11
00	00	01	10	00	0	0	0	1	00	00	00	01
01	00	10	00	00	0	0	1	1	01	00	00	10
10	00	00	00	00	0	1	1	1	10	00	01	11
11	d	d	d	d	d	d	d	d	d	d	d	d

State Assigned Table

```
state0: if(cash_in == 2'b00)
            begin
                next_state = state0;
                purchase =0;
                cash_return =0;
            end
        else if(cash_in == 2'b01)
            begin
                next_state=state1;
                purchase = 0;
                cash_return = 0;
            end
        else if(cash_in == 2'b10)
            begin
                next_state=state2;
                purchase=0;
                cash_return=0;
            end
        else if(cash_in == 2'b11)
            begin
                next_state = state0;
                purchase = 1;
                cash_return = 2'b01;
            end
```

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15 Tk Product Case (Code Snippet)

Present State	Next State				Output							
	Y_2Y_1				z				c_2c_1			
(y_2y_1)	(w_2w_1)				(w_2w_1)				(w_2w_1)			
	00	01	10	11	00	01	10	11	00	01	10	11
00	00	01	10	00	0	0	0	1	00	00	00	01
01	00	10	00	00	0	0	1	1	01	00	00	10
10	00	00	00	00	0	1	1	1	10	00	01	11
11	d	d	d	d	d	d	d	d	d	d	d	d

State Assigned Table

```
state2: if(cash_in == 2'b00)
            begin
                next_state = state0;
                purchase =0;
                cash_return =2'b10;
            end
        else if(cash_in == 2'b01)
            begin
                next_state=state0;
                purchase = 1;
                cash_return = 0;
            end
        else if(cash_in == 2'b10)
            begin
                next_state=state0;
                purchase=1;
                cash_return=2'b01;
            end
        else if(cash_in == 2'b11)
            begin
                next_state = state0;
                purchase = 1;
                cash_return = 2'b11;
            end
```

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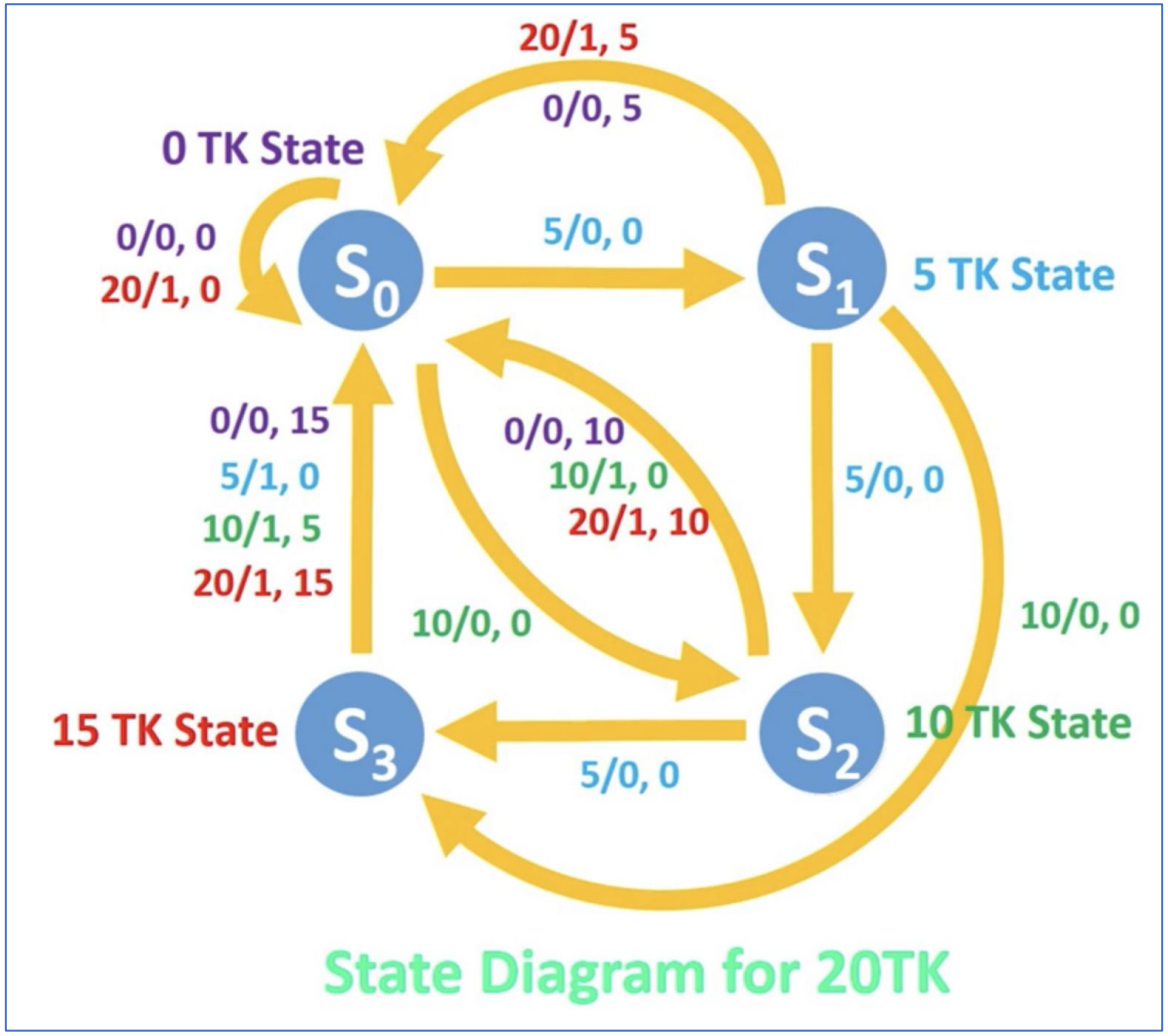
20 Tk Product Case (State Diagram)



Thank you!