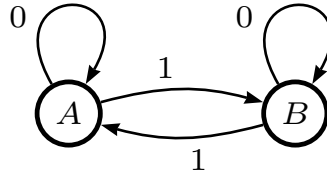
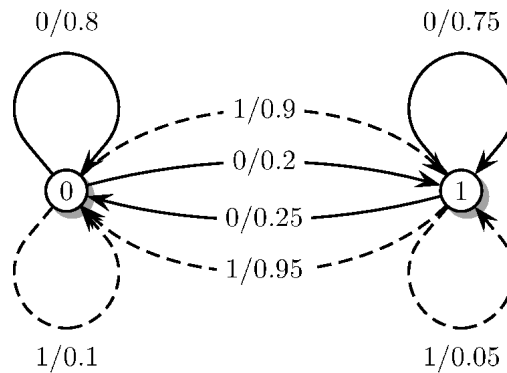


**Problem 1** (10 Points) What is the state space and the control space for the following deterministic Finite State Machine (FSM)? If the initial state of the FSM is  $A$ , then what is the system trajectory for the following input sequence 010001110? Design a time-optimal feedback control law that makes the system go to the state  $A$  in minimum time (steps).



**Problem 2** (10 Points) If the initial state of the given stochastic FSM is 0, then what is the expected value of the next state if the input is 0? What is the expected value of the next state if the current state is 0 and the input is 1? What control value minimizes the expected value of the next state when the current state is 0? Design a feedback control law that minimizes the expected value of the next state. (**Note:** If a random variable can have value  $x_1$  with probability  $p_1$  and value  $x_2$  with probability  $p_2$ , then its expected value is  $p_1x_1 + p_2x_2$ .)



**Problem 3** (10 Points) Derive the PDE for the heat equation for a rod that has a distributed heat source along its length.