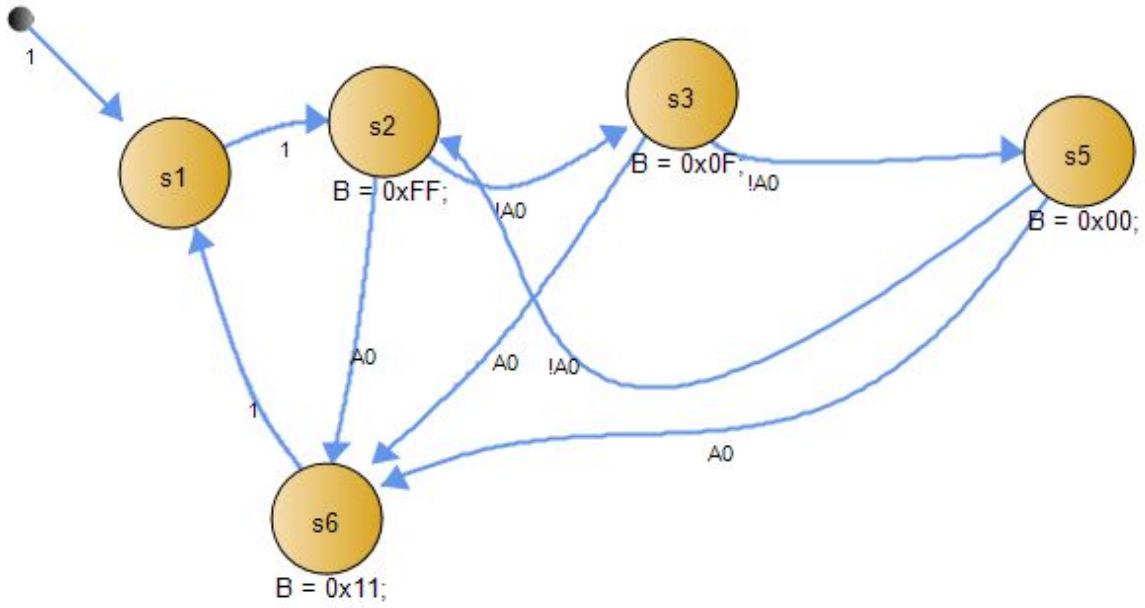
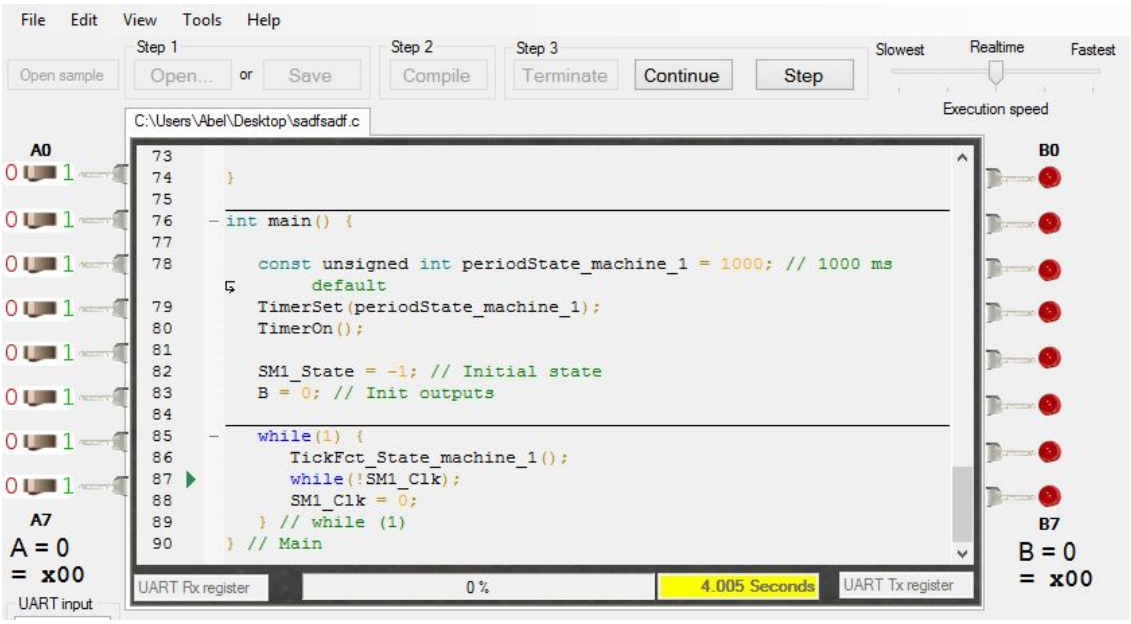
State Machine Programming Tutorial

This tutorial will show you have to light up some lights in a specific pattern using state machines.
State machines are really important because they allow you to visualize your system. This can make programming them really easy. Let's look at the following state machine:



In this state machine, you can see how we have our starting state is s1. From that state, we go to s2. In s2 we set B = 0xFF. This means we are lighting up everything. We then go on to state s3 where we do B = 0x0F; We only light up half the lights this time. We then go on to s5 where we do not light up anything. From here, the state machine goes to s2. If at anytime A0 is turned on, we go to s6 and light up the first and 5th light.



As you can see from the picture above, this is the RIMS environment which simulates a simple microprocessor. We have our inputs A0 - A7 and our outputs B0 - B7. We are using a timer of 1 second so each state will have 1 second time for outputs.

Let's take a look at some of the code:

```
TickFct_State_machine_1() {
   switch(SM1_State) { // Transitions
      case -1:
         SM1_State = SM1_s1;
         break;
         case SM1_s1:
         if (1) {
            SM1_State = SM1_s2;
         }
         break;
      case SM1_s2:
         if (!A0) {
            SM1_State = SM1_s3;
         }
         else if (A0) {
            SM1_State = SM1_s6;
         }
         break;
```

This code above is from our state machine logic that decides which state should we be in next. You can see in case SM1_s2, we go to SM1_S3 if A0 is not pressed. If it is pressed, we go to SM1_s6 which is another state. The other states all follow this same approach. You simply tell the microprocessor which state to go to next depending on the given inputs.

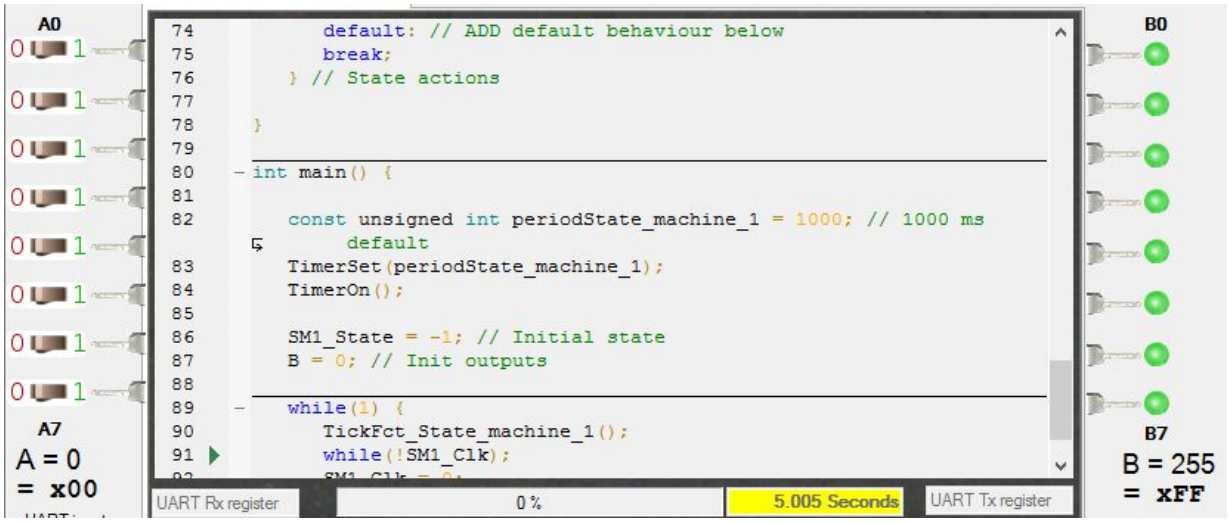
Let's now take a look at the code for doing something once we are in a state:

```
switch(SM1_State) { // State actions
   case SM1_s1:
      break;
   case SM1_s2:
      B = 0xFF;
      break;
   case SM1_s3:
      B = 0x0F;
      break;
   case SM1_s5:
      B = 0x00;
      break;
   case SM1_s6:
      B = 0x11;
      break;
   default: // ADD default behaviour below
   break;
} // State actions
```

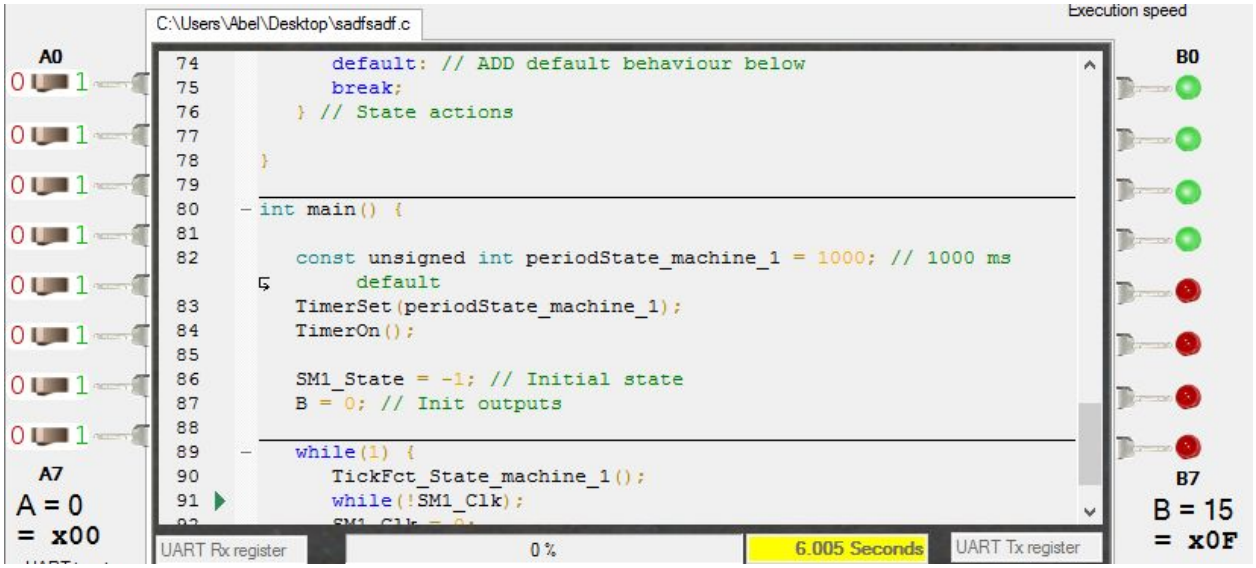
In this code above, you can see the actions that take place while we are in each state. Some states have no action while others are sending output B a specfic pattern.

Let's now take a look at the ouput at important states:

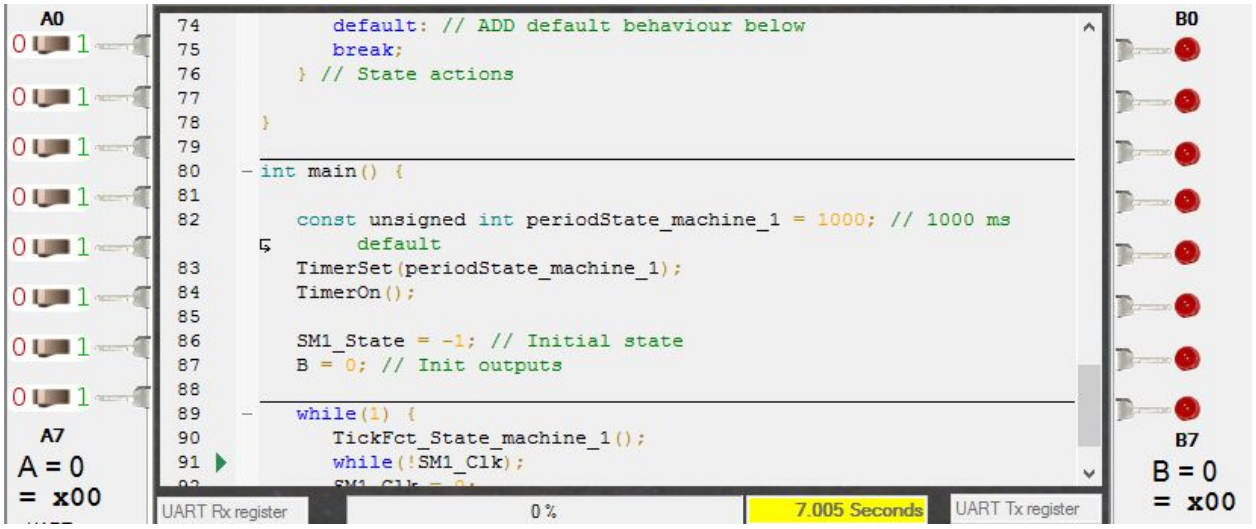
S2:



S3:



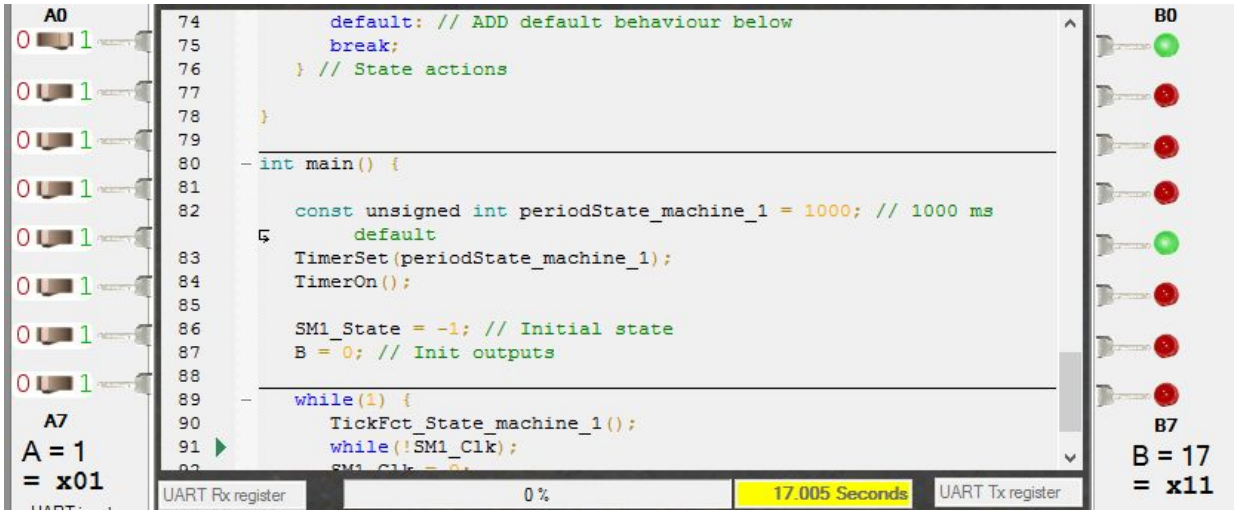
s5:



:

s6:

This state only happens when A0 is engaged. You can look in the top left corner of the picture and see that the switch was pushed.



As you guys can see from the pictures, the right outputs are on B.

This tutorial has given you a basic understanding of how to program state machines. It is important to make sure that your state machine should never be able to go to two different states at any given time.