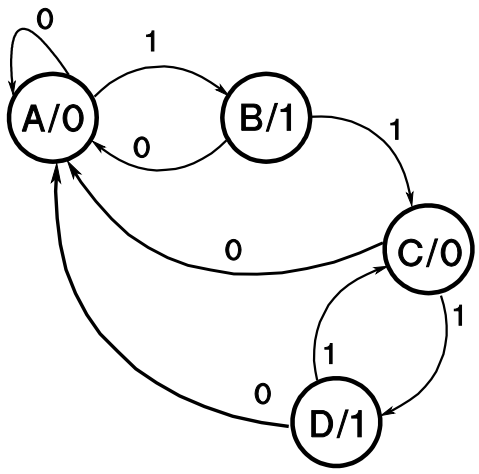
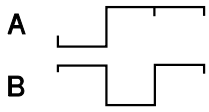
CS150 - Computer Organization and Architecture
Some Sequential Circuit Problems

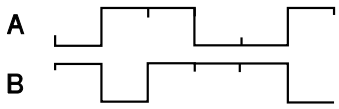
1. Derive the state transition table, choose a state assignment, and write the next state and output equations for the following state diagram.



2. Design a circuit which has one input X and two outputs A and B. When X is 0, the output should be:



When X is one, the above sequence should expand to



(That is, the second sequence is an "extension" of the first.)

3. Develop the *state diagram* for a variable counter circuit. This circuit has two inputs, A and B, two outputs X and Y, and should behave as follows:

- For $AB = 00$, the counter output should be 00 (i.e., stopped)
- For $AB = 01$, the counter output should be 00, 01, 00, 01, etc. (i.e., the counter should count to 1, then back to zero, etc.)
- For $AB = 10$, the counter output should be 00, 01, 10, 00, 01, 10, etc. (i.e., the counter should count up to 2, then back to ze ro)
- For $AB = 11$, the counter output should be 00, 01, 10, 11, 00, 01, 10, 11, etc. (i.e., the counter should count up to 3.

If the value of AB changes during a counting sequence, the counter output should go to 00 at the next clock cycle, and then count according to the new value of AB.

4. (This one is a more difficult problem!) Assume that a sequential network has two outputs Z_1 and Z_2. The inputs (X_1X_0) represent a 2-bit binary number N. If the present value of N is greater that the previous value, then Z_1 should be a 1. If the present value of N is less than the previous value, then Z_2 should be a 1. Otherwise, both Z_1 and Z_2 should be zero, including the situation when the first value of N is received (in which case, we don't have a "previous value." Draw the state graph for the circuit (*NOTE:* it is pretty large!).