Reading assignment:  Read Chapter 3 of Sipser’s text.

Problems:

1. Draw the state diagram of the DFA that is the result of converting the following NFA to a DFA using the subset construction. Only show the states that are reachable from the start state.

```
   s ----> p
   |       |
   | 0     | 1  |
   v 0    v 1  
   q ----> r
```

2. Sipser’s text (1st or 2nd edition) Problem 3.7.

3. Give a Turing machine diagram for a Turing machine that on input a string \( x \in \{0, 1\}^* \) halts (accepts) with its head on the left end of the tape containing the string \( x' \in \{0, 1\}^* \) at the left end (and blank otherwise) where \( x' \) is the successor string of \( x \) in lexicographic order; i.e. the next string in the sequence \( \epsilon, 0, 1, 00, 01, 10, 11, 000, \ldots \) in which the strings are listed in order of increasing length with ties broken by their corresponding integer value. (Briefly document your TM.)

4. Turing in his paper said that the 2-dimensional natural of the paper is not essential. In this question you will show why that is the case:

A Turing machine with a 2-dimensional tape is like a 1-tape TM except that it marked with an infinite 2-dimensional grid of cells that are all blank, except for the input which is given in the cells starting with the cell under the read/write head and continuing with the sequence of cells immediately to the right. Additional changes are that

- the transition function \( \delta \), is \( \delta : Q \times \Gamma \rightarrow Q \times \Gamma \times \{L, R, U, D\} \) where \( U \) and \( D \) indicate moves up and down one cell.
- there is no end of the tape.

Give an implementation level description of how an ordinary 1-dimensional Turing machine can simulate a 2-dimensional one; that is, the 1-dimensional TM should accept, reject, or run forever on exactly the same set of inputs as the 2-dimensional one does.