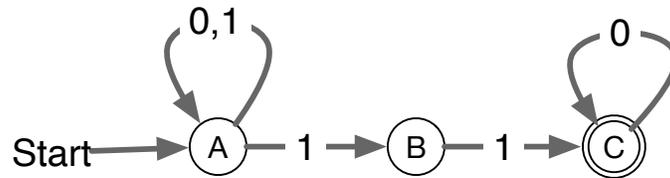


Practice Midterm

1. Given the following finite automaton:



1. Explain why this is a non-deterministic automaton.
 2. Convert the NFA to a DFA.
2. Assume that a machine has a hardware sorting network — a hardware device built into the CPU just like a floating point adder— that determines simultaneously the maximum and minimum of an array of length up to 8.
 1. What is the number of comparisons needed to determine the maximum of n elements?
 2. How would you use recursion in order to determine the maximum using the sorting network?
 3. Give a recursion for the runtime of the maximum finding algorithm.
 4. Determine its asymptotic runtime using the Master Theorem.
 3. A recursive algorithm on an array of n elements is given by the following Python pseudo-code. Use the Master Theorem in order to determine its asymptotic runtime. (The brackets are slices.)

```
def algo(array):  
    n = len(array)  
    if n < 10:  
        return sorted(array)  
    ar1 = algo[0:2n/6]  
    ar2 = algo[1n/6:3n/6]  
    ar3 = algo[2n/6:4n/6]  
    ar4 = algo[3n/6:5n/6]  
    ar5 = algo[4n/6:6n/6]  
    return ar1[1:1n/6]+ar2[1:1n/6]+ar3[1:1n/6]+ar4[1:1n/6]+ar5
```

4. Create a B-tree of height 1 (root and one set of children) that with a single deletion will turn into a B-tree of height 0 (only a root).
5. Calculate the values for the split pointer and the level of an LH hash table with 10 buckets. Then calculate the buckets were records with hash of key 5, 6, 7, 8, 9, and 10 are inserted.