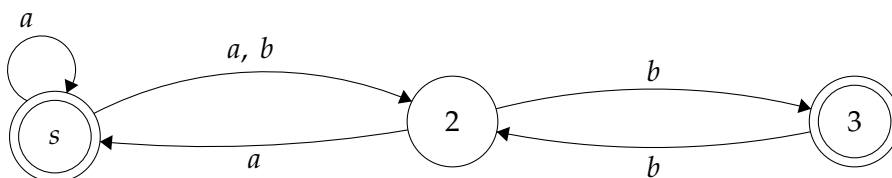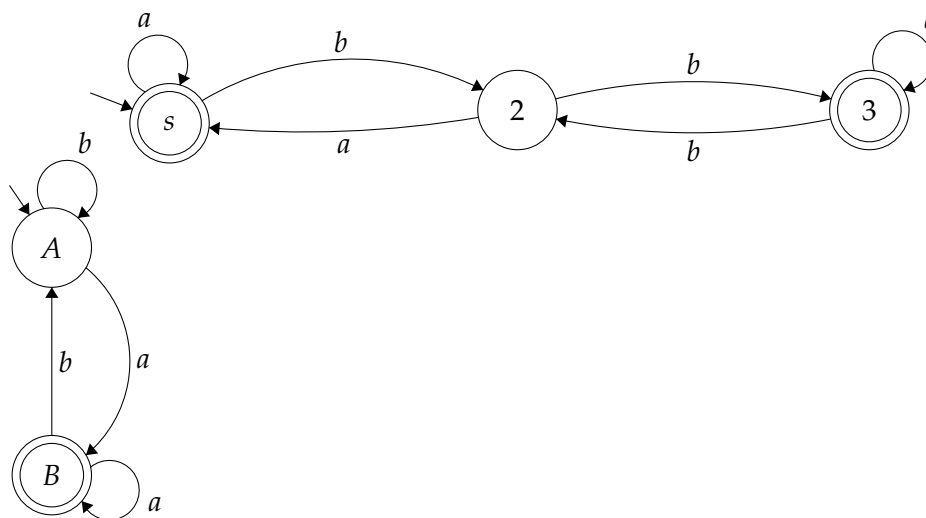**Reading:** Now read through the end of section 1.3—that is, read about "GNFAs" too. First focus on the proof in section 1.2 that every NFA has an equivalent DFA. Then before you read the proof of going from DFA/NFA/GNFA to a regular expression, reflect how it completes a cycle of showing that all four formalisms are equivalent in terms of the class of languages they denote: the *regular languages*. The notes https://www.cse.buffalo.edu/r̃egan/cse396/CSE396.regexpalg in the "Extra Resources" section of the course webpage give an alternate way to picture the algorithm in that proof. Also look at https://cse.buffalo.edu/ regan/cse396/CSE396MNT.pdf for Thursday.

(1) This problem is "HW2 Online Part" on *TopHat*, worth 20 pts. as before. Here is the NFA for the first five short-answer questions on it, which will help cut down scrolling:

(2) Call the following two DFAs M_1 (the one with three states that looks like N above) and M_2. Use the Cartesian product construction to design DFAs M_3 and M_4 such that $L(M_3) = L(M_1) \cap L(M_2)$ and $L(M_4) = L(M_1) \triangle L(M_2)$, where $\triangle$ is **symmetric difference**, which does XOR on the languages. (18 + 6 = 24 pts.)

(3) For each of the following languages A over the alphabet $\{a, b\}$, write a regular expression r such that $L(r) = A$, and then give an NFA N_r such that $L(N_r) = A$. Well, if you give a DFA, that counts as an NFA, but in one or two cases you may find the NFA easier to build especially once you have r. For parts (b) and (c), note that a string can be broken uniquely into maximal "blocks" of consecutive same letters. For instance, in "Tennessee" the blocks are T, e, nn, e again, ss, and ee.

(a) The language of strings in which every a is followed immediately by a b but not by bb.

(b) The language of strings in which every a belongs to a "block" of at least 2 a's and every b belongs to a block of at most 3 b's.

(c) The language of strings with no block of 3 or more b's, and in which every block of 2 b's has an odd number of chars before it. (**Note inserted words "or more" as a correction.** 6 + 9 + 9 = 24 pts., for 68 total on the set)