Homework 7 - Computer Science 461 **Name:** ______________________

Due Monday, March 24.

1. Use the algorithm we discussed in class (see the notes from Wed, March 5) to convert the following context-free grammar to Chomsky normal form:

$$S \to ASA \mid A \mid \epsilon$$
$$A \to aa \mid \epsilon$$

2. Give a detailed written description (but not a state diagram) of a Turing machine that accepts the following language.

$$L = \{w \in \{a, b\}^* : w \text{ has an equal number of } a\text{'s and } b\text{'s}\}.$$

3. A `binary-incrementer` is a function that reads a binary number from a tape, and replaces it with the binary number that is one greater. So 111 becomes 1000, for example. Draw a state diagram for a Turing machine that evaluates the `binary-incrementer` function. Hint: You should only need four or five states.

4. If you have a Turing machine that computes the `binary-incrementer` function, explain how you could create a Turing machine that reads a string of n 1's, and replaces it with the binary integer that represents n. For example 1111 would become 100 since 100 represents $n = 4$ in binary. You don't need to draw a state diagram, but explain in detail how you would incorporate the `binary-incrementer` machine into your new Turing machine.

5. Let Σ be an alphabet, and let $L \subset \Sigma^*$ be a language. If L is decidable, prove that its complement $\overline{L}$ is also decidable.

6. Why doesn't the same argument show that the complement of an acceptable language is acceptable?