Directions: The below problems involve material from Chapter 3 and 4 of the textbook.

Please note the following.

1. With the exception of graphs and figures, you must type your solutions.
2. You must submit a physical copy of the HW **during class** on the given due date.
3. In addition, **you must submit an electronic copy using eLC** by 5PM on the due date (an assignment on eLC has been created). Please do not email the HW to the instructor or TAs.

Unless otherwise stated, the above policy will be used for the remainder of the semester.

The maximum raw score is 90, but this will be scaled to 100.

1. **[20 points]** Provide high level proofs that the set of Turing decidable languages is closed under
   (a) intersection.
   (b) the Kleene star.
2. **[10 points]** Given a DFA M and regular expression R, is the problem of determining whether $L(M) = L(R)$ decidable? Explain why or why not.
3. **[10 points]** Let $ALL_{DFA} = \{\langle D \rangle | D \text{ is a DFA and } L(D) = \Sigma^*\}$. Prove that this language is decidable.
4. **[10 points]** Let $\varepsilon_{CFG} = \{\langle G \rangle | G \text{ is a CFG that generates } \varepsilon\}$. Prove that this language is decidable.
5. **[10 points]** Let $A = \{\langle R, S \rangle | R, S \text{ are DFAs and } L(R) \subseteq L(S)\}$. Prove that this language is decidable.
6. **[30 points]** Write a Java program implementing the Turing machine M_2 shown in Fig. 3.8 of the text. You may assume that M_2 is a fixed part of the program and that the input to the program is a string of 0s (read from the console). The output should be the sequence of configurations that the machine enters (similar to the the sequence shown on page 144). Submit the program's output for the input 00 and 0000 with your printed homework. Your completed source file should be submitted to eLC.