Notes:

- Read Course Information: Section 7 (Miscellaneous) and Section 9 (Academic Dishonesty or Misconduct).
- When you are giving a construction, example, etc., provide a justification with your argument. Your solutions to numerical problems must contain the derivation of your answers. In all of your presentations, strive for correctness, completeness, and clarity. When in doubt about the assumptions of problems, the interpretations of wording, etc., consult the instructor.
- You should strive to complete all problems assigned, and a subset of them will be graded.

1. Read the notes above carefully.
   Let $\Sigma = \{0, 1\}$, and $L$ be an arbitrary regular language over $\Sigma$. Prove that the following language:
   \[ K = \{xy \mid x, y \in \Sigma^* \text{ and } yx \in L\} \]
   is regular.

2. Given two regular expressions $r_1$ and $r_2$ over an alphabet $\Sigma$:
   (a) Show that the “regular-expression equation” $r = r_1 + r r_2$ (with “unknown” $r$) is satisfied by the regular expression $r_1 r_2^*$. 
   (b) Assume that $\epsilon \notin L(r_2)$. Prove that every regular expression $r$ satisfying the “regular-expression equation” $r = r_1 + r r_2$ denotes the same language as the regular expression $r_1 r_2^*$.

3. ... More problems will be given in later version(s).