1 Instructions
1. The homework is due on September 14, in class.
2. Each question is worth 2 points.
3. Attempt as many problems as you can. You will be given partial credit, as per the policy discussed in class.

2 Problems
1. Let $A$ and $B$ be propositions. Argue that the following two statements are tautologies:
   (a) $A \rightarrow A$,
   (b) $[A \land (A \rightarrow B)] \rightarrow B$
2. Explain the difference between the converse of a theorem and its contra-positive.
3. Use mathematical induction to show that $7^n - 2^n$ is divisible by 5, for all $n \geq 0$.
4. Let $S$ and $T$ denote two sets, which are subsets of a set $U$. Let $S'$ and $T'$ denote the complements of $S$ and $T$ in $U$ respectively. Prove the following set equivalence:
   $$(S \cup T)' = S' \cap T'.$$
5. Let $\Sigma = \{0, 1\}$ denote an alphabet. Enumerate five elements of the following languages:
   (a) Even binary numbers,
   (b) The number of zeros is not equal to the number of ones in a binary string.