1. Design a convention for representing negative integers in unary notation. Using your convention, sketch an approach for some calculations with negatives, such as $x + y$ and $x \times y$ when one or both of the operands is negative.

2. Using the “ADDER”, “SUBTRACTOR”, “COMPARER”, and “MULTIPLIER” machines discussed in class to draw block diagrams for TM’s to compute the following:
   
   (a) $f(n) = n(n + 1)$
   
   (b) $f(n) = 2^n$
   
   (c) $f(n) = n!$

3. Construct a non-deterministic TM to accept $L = \{ww : w \in \{0, 1\}^+\}$.

4. Design at a high-level a TM to accept the language $\{ww^R\}$. You may use pseudo-code with appropriate macroinstructions, but you should justify why each is possible to implement within a TM.

5. Design at a high-level a TM to accept the language $\{w_1w_2 : w_1 \neq w_2; |w_1| = |w_2|\}$. You may use pseudo-code with appropriate macroinstructions, but you should justify why each is possible to implement within a TM.

6. Sketch a TM that enumerates the language $\{a^n b^n c^n : n \geq 1\}$.

7. Suppose that $S_1$ and $S_2$ are countable sets. Show that $S_1 \cup S_2$ and $S_1 \times S_2$ are also countable.

8. Prove that the set of all real numbers is not countable.

9. Show that if $L$ is not R.E., then $\overline{L}$ cannot be recursive.

10. Is the family of recursive languages, $L_{REC}$, closed under concatenation?