1. Prove that $\text{SPACE}(n^2)$ is different from $\text{SPACE}(n^3)$ on multi-tape TM’s from scratch by proving a self-contained specialized version of the space hierarchy theorem.

2. Exercise 7.17 on page 276 (what is wrong with the G3C to Minimum Vertex-Deletion Bipartite Subgraph reduction).

3. Verify the P and Exp are closed under polynomial-time reductions, but E is not (Exercise 6.6 on page 188).

4. Prove or disprove the following:
   a. If $L^*$ is regular then $L$ is regular.
   b. If $L = L_1 + L_2$ is regular and $L_2$ is finite, then $L_1$ is regular.
   c. Is the class of regular languages closed under infinite union?
   d. Is the language $\{xw.xR|x, w \in (0+1)^+\}$ regular?

5. A 2-stack machine has a finite state control and scans an input symbol, pops a character from each stack, and then pushes new characters onto the stacks while changing state at each step. More formally, a 2-stack machine’s transition function maps a (state,input char, 1st stack char, 2nd stack char) quadruple to a (state, 1st stack replacement char, 2nd stack replacement char) triple). Assume that $\varepsilon$’s can be used to avoid reading the input, popping a stack and/or pushing anything new on a stack.

Prove that 2-stack machines decide the same languages as Turing Machines (like our TMs, a 2-stack Machine accepts its input by entering a special “Yes” state). You may assume that a special symbol “#” ends a the input and is “popped” when a stack is empty.