A. Show that the time complexity class P is closed under concatenation.

B. A language B is *NP-hard* if any language $A \in$ NP can be reduced to B in deterministic polynomial time. A language B is *PSPACE-hard* if any language $A \in$ PSPACE can be reduced to B in deterministic polynomial time. Show that any PSPACE-hard language is also NP-hard.

C. Let A be the set of all incompressible (according to our usual compression scheme) strings over $\{0, 1\}$. Is A recognizable?

D. In the USA, (simplified) postal addresses are formatted as in the two examples below. The first line is the *addressee*, an arbitrary string containing no carriage returns (ASCNCR). The second line is either a street address or a P.O. box. A *street address* is one or more digits followed by an ASCNCR. A *P.O. box* is "PO Box" followed by one or more digits. The third line consists of a city name (an ASCNCR with no commas), followed by a comma, followed by a two-letter state/territory code, followed by a ZIP code. The ZIP code is either five digits, or five digits followed by a dash and four digits. Write a regular expression for USA postal addresses as just described.

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E. Let $A = \{w\#t : w, t \in \{0,1\}^*, w \text{ is a substring of } t\} \subseteq \{0,1,\#\}^*$. Use the pumping lemma to prove that A is not context-free.

F. Let $A = \{\langle M \rangle : M \text{ is a Turing machine and } L(M) \text{ is finite}\}$. Show that A is not recognizable, by describing a mapping reduction from $\overline{\mathrm{HALT}_{\mathrm{TM}}}$ to A.