In these exercises, “the handout” refers to the article “Self-referencing, Uncountability, and Uncomputability” on the 421/501 homepage.

(1) Let 
\[ L = \{ \langle M \rangle \mid M \text{ is a T.m. that halts on input } \epsilon \} \]
(where \( \epsilon \) is the empty string). Show that \( L \) is (Turing) undecidable but (Turing) recognizable. What can you say about the complement of \( L \)?

(2) Let 
\[ L = \{ \langle M \rangle \mid M \text{ is T.m. that uses all of its states} \} \]
(i.e., for each state, \( q \), of \( M \), there is some input to \( M \) on which \( M \) reaches \( q \)). Show that \( L \) is (Turing) undecidable but (Turing) recognizable. What can you say about the complement of \( L \)?