(1) Recall that
\[ \text{HALT}_{\text{TM}} = \{ \langle M, w \rangle \mid M \text{ is a Turning machine that halts on input } w \} \].

Give a direct proof that \( \text{HALT}_{\text{TM}} \) is undecidable (i.e., without using the fact that \( \text{A}_{\text{TM}} \) is undecidable); do so using the same strategy used to prove that \( \text{A}_{\text{TM}} \) is undecidable (see the proof Theorem 4.11 in [Sip], page 207, or class notes on 10.22): assume that some Turing machine \( H \) decides \( \text{HALT}_{\text{TM}} \), and describe how to build a Turing machine \( D \) such that when you consider \( D(\langle D \rangle) \) (i.e., the outcome of \( D \) on input \( \langle D \rangle \)), you get a contradiction.

(2) Is \( \text{HALT}_{\text{TM}} \) (defined above) recognizable? Is the complement of \( \text{HALT}_{\text{TM}} \) recognizable? Justify your answers.