

1. Show that the language $L = \{1^{2^n} \mid n \geq 0\}$ is not regular.
2. Show that there exists a one-tape deterministic TM M that accepts L in time $O(n \log n)$.
3. Show that any language accepted by a one-tape deterministic TM M in time $o(n \log n)$ is regular. (Note that in the previous question we have “big-Oh,” while in this question we have “little-oh.”)