Homework 5

due March 3rd in class

1. Show that if a TM decides a language using $S(n)$ space (where $S(n) \geq \log n$), then it decides the language in $2^{O(S(n))}$ time.

2. Let $\Sigma = \{0, 1, \#\}$. Consider the language $L \subseteq \Sigma^*$ consisting of the words

$0\#1\#
00\#01\#10\#11#
000\#001\#010\#011\#100\#101\#110\#111#
\vdots$

(If the pattern is not clear, please don’t hesitate to ask.) Show that (i) this language can be decided using $O(\log \log n)$ space; (ii) the language is not regular.

Fun fact (which you do not need to prove): If a language can be decided using $o(\log \log n)$ space\footnote{Little-o notation: https://en.wikipedia.org/wiki/Big_O_notation#Little-o_notation} then it must be regular.