Homework Assignment #3
Due: October 6, 3:30 p.m.

Recall that the recursive algorithm for fast multiplication from class. Its worst-case running time on n-bit input numbers can be described by:

$$\begin{aligned} T(1) &= 1 \\ T(2) &= 1 \\ T(3) &= 1 \\ T(n) &\leq T(\lfloor n/2 \rfloor) + T(\lceil n/2 \rceil) + T(\lceil n/2 \rceil + 1) + 5n \text{ for } n \geq 4 \end{aligned}$$

Prove that $T(n)$ is $O(n^{\log_2 3})$.

(Note that the Master Theorem does not apply to this recurrence because of the "+1" in the one of the arguments in the recurrence relation, so you are going to have to prove it from scratch.)

Hints: Remember that when proving something by induction, making the claim a little stronger sometimes makes it easier to prove, as in the September 24 lecture. If your answer is longer than a page, it is too long.