The game is a random walk on that line. Let $E_i$ be the event that A wins the game starting with # $i$. $P(E_i) =$?

Condition on outcome of first flip and use LTP.

$p_i = P(E_i) = P(E_i | H)P(H) + P(E_i | T)P(T)$

$= \frac{1}{2}(p_{i-1} + p_{i+1})$ because $P(E_i | H) = P(E_{i-1})$ and $P(E_i | T) = P(E_{i+1})$

$2p_i = p_{i-1} + p_{i+1}$

$p_i - p_{i-1} = p_{i+1} - p_i$

$i = 0$: $p_0 = p_1 - p_0 = p_1$

$p_2 = 2p_1$

$p_3 = 3p_1$

$p_i = ip_i$ for $0 \leq i \leq N$

$1 = p_N = Np_i$

$p_i = \frac{1}{N}$

$p_0 = i p_1 = \frac{i}{N}$