1. Flip a fair coin repeatedly until you get two heads in a row (HH). On average, how many flips should this take?

   - First, try modeling this random experiment as a DFA.

   - Assign to each transition a number in $[0, 1]$, representing the probability of crossing that transition given that we are already in the given state.
     Congrats! You made a *Markov Chain*.

   - Let E_i be the average number of transitions (tosses) it takes to get from state i in your DFA to the accept state. Can you find a relationship between the E_is?

2. What if we flip until we get heads followed by tails (HT)? Is the answer the same as (1)?

3. Flip a fair coin repeatedly n times. How many two heads in a row (HH) do we expect to see? How about three heads in a row (HHH)?

   - First, let's make an educated guess. How many heads do we expect? For each of those heads, how many of the next tosses will also be heads on average?

   - Let's formalize! *Hint: Linearity of...?*

4. Argue that within a sequence of n fair coin flips, we are expected to see some consecutive heads (or tails) of logarithmic length.

5. **Harder:** How many coin flips will it take on average to get n heads in a row?