1. There are \( n \) fish in a lake, some of which are green and the rest blue. Each day, Helen catches 1 fish. She is equally likely to catch any one of the \( n \) fish in the lake. She throws back all the fish, but paints each green fish blue before throwing it back in. Let \( G_i \) denote the event that there are \( i \) green fish left in the lake.

(a) Show how to model this fishing exercise as a Markov chain, where \( \{G_i\} \) are the states. Explain why your model satisfies the Markov property.

(b) Find the transition probabilities \( \{p_{ij}\} \).

(c) List the transient and the recurrent states.

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3. Consider the following Markov chain, with states labelled from \( s_0, s_1, \ldots, s_5 \):

![Diagram of a Markov chain with states S0 to S5 and transition probabilities labeled.]

Given that the above process is in state \( s_0 \) just before the first trial, determine by inspection the probability that:

(a) The process enters \( s_2 \) for the first time as the result of the \( k \)th trial.
(b) The process never enters $s_4$.
(c) The process enters $s_2$ and then leaves $s_2$ on the next trial.
(d) The process enters $s_1$ for the first time on the third trial.
(e) The process is in state $s_3$ immediately after the $n$th trial.