Figure 1: The Transition Diagram Implied by Question 2

While Question 2 does not tell us *where* we start, we do know that if we ever hit state 0, we must move to state 1 in the following step. This state transition diagram makes clear that the **TPM** is of form:

$$
\mathbf{P} = \begin{bmatrix}
0 & 1 & 0 & 0 & \dots \\
1-p & 0 & p & 0 & \dots \\
0 & 1-p & 0 & p & \dots \\
\vdots & \vdots & \vdots & \vdots & \ddots
\end{bmatrix}.
$$

Note that $\mathrm{diag}\mathbf{P} = \mathbf{0}$ (why?) and that the lower off-diagonal corresponds to back-steps while the upper corresponds to forward-steps. We also can easily see that row sums indeed always equal 1.