

A. From the textbook: Problems 3.1, 3.3, 3.5, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10

B. *Binary Symmetric Markov Source*: Consider the binary Markov source: $\{X_n\}_{n=1}^{\infty}$, $X_n \in \mathcal{X} = \{0, 1\}$, with

$$\Pr\{X_{n+1} = j | X_n = i\} = \begin{cases} p & \text{if } i = j \\ 1 - p & \text{otherwise} \end{cases},$$

$n \geq 1$, where $p \in [0, 1]$.

- (a) Find the initial state distribution $(Pr\{X_1 = 0\}, Pr\{X_1 = 1\})$ required to make the source $\{X_n\}$ stationary. Assume in the next questions that the source is stationary.
- (b) If $p = 1/2$, show that $\{X_n\}$ is a discrete memoryless source and compute its entropy rate.
- (c) Suppose that $p = 1$. Is $\{X_n\}$ irreducible? Is it ergodic?
- (d) Repeat part (c) if $p = 0$.
- (e) For $p \in (0, 1)$, compute the entropy rate of $\{X_n\}$ and plot it versus p .