1. Let

\[ C = \{0, 10, 111, 1101, 11000, 11011\}. \]

Show that \( C \) is instantaneous.

Given a source \( S \) with message alphabet \( M = \{a, b, c, d, e, f\} \) and probability distribution

\[
P(S = a) = \frac{1}{8}, P(S = b) = \frac{1}{32}, P(S = c) = \frac{1}{16}, \]

\[
P(S = d) = \frac{1}{2}, P(S = e) = \frac{1}{4}, P(S = f) = \frac{1}{32}, \]

consider the encoding scheme

\[ f : M \rightarrow C \]

\[ f : a \rightarrow 111, b \rightarrow 11001, c \rightarrow 1101, d \rightarrow 0, e \rightarrow 10, f \rightarrow 11000. \]

What is the average codeword length of \( f \)?

Show that \( f \) achieves the optimal lossless data compression for \( S \).

2. Solve the problems concerning the Adventures of Dakota Smith, at

www.dllab.caltech.edu/cbs175/handouts/hw2.html