|  |  |
| --- | --- |
| Letter | Probability |
| a | 0.4 |
| b | 0.2 |
| c | 0.15 |
| d | 0.15 |
| e | 0.1 |

1. Find this source's entropy.
2. Show that the simple binary coding is inefcient.
3. Find the Hufman code for this source. What is its average code length?

**Problem 6.18**: Speech Compression

When we sample a signal, such as speech, we quantize the signal's amplitude to a set of integers. For a *b*-bit converter, signal amplitudes are represented by 2b integers.

Although these integers could be represented by a binary code for digital transmission, we should consider whether a Hufman coding would be more efcient.

1. Load into Matlab the segment of speech contained in y.mat . Its sampled values lie in the interval (-1, 1). To simulate a 3-bit converter, we use Matlab's round function to create quantized amplitudes corresponding to the integers [0l23456 7J.
   1. y quant = round(3.5\*y + 3.5) ; Find the relative frequency of occurrence of quantized amplitude values. The following Matlab program computes the number of times each quantized value occurs.
   2. for n=0:7; count(n+l) = sum(y quant == n); end; Find the entropy of this source.
2. Find the Hufman code for this source. How would you characterize this source code in words?
3. How many fewer bits would be used in transmitting this speech segment with your Hufman code in comparison to simple binary coding?

**Problem 6.19**: Digital Communication

In a digital cellular system, a signal bandlimited to 5 kHz is sampled with a two-bit A/D converter at its Nyquist frequency. The sample values are found to have the shown relative frequencies.