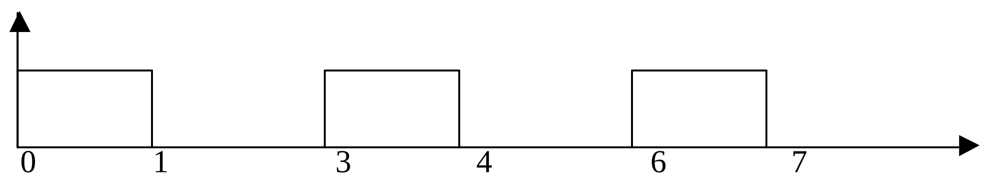
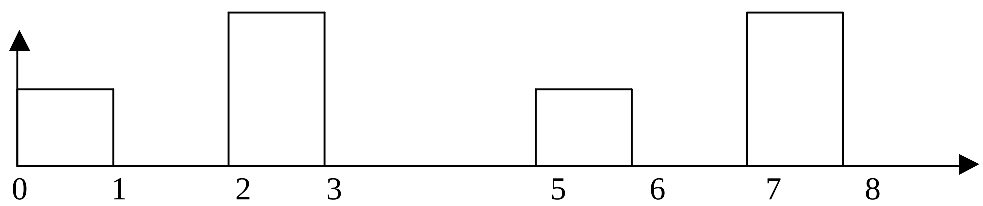
EE 3140 Homework #4

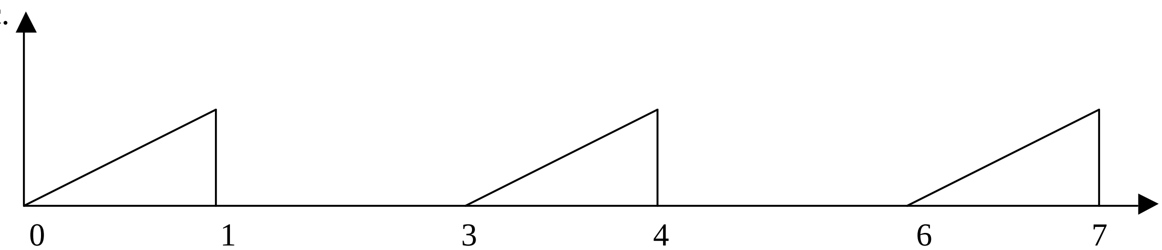
1. Find and sketch the time-autocorrelation function $R_X(t)$, for the following periodic sequences:
   a. +, +, -, -, +, +, +, -
   b. +, -, -, +, -, -, -
   c. +, -, +, -, +, -, -, -
2. Find and sketch the time-autocorrelation function $R_X(t)$, for the following periodic functions:
   a.



   b.



   c.



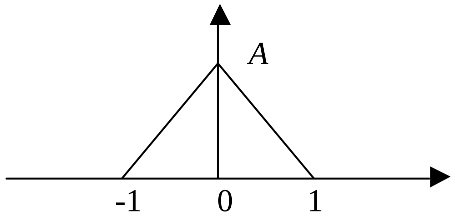
3. Find the ensemble autocorrelation function $R_X(t)$, for $A \cos(w\, t)$, where A is a random variable with mean μ.
4. Find the ensemble autocorrelation function $R_X(t)$, for $X(t) = A \cos(3t + q)$, where q is a uniformly distributed random variable in the interval $[-\pi, \pi]$.
5. Find the Huffman binary and ternary codes for messages with the following probabilities:
   a. 0.5, 0.2, 0.12, 0.1, 0.04, 0.02, 0.01, 0.01
   b. 0.4, 0.3, 0.2, 0.04, 0.04, 0.02
   c. 0.3, 0.28, 0.20, 0.10, 0.06, 0.03, 0.02, 0.01

   Find the average length in each case.
6. Find the binary Shanon-Fano code for problem 5(c).
7. Find the maximum rate at which data can be sent over a 20dB, 3.4KHz link.
8. Find the maximum number of 50dB, 4KHz signals that can be sent over a 30dB, 100KHz link.

9. Find the power spectral density for:

$$R_X(t) = A \cos 2\pi f t$$

10. Find the power spectral density corresponding to $R_X(t)$ shown below:



11. For the sequence

$$\ldots, 1, 2, 3, 4, 5, 6, 5, 4, 3, 2, 1, 1, 1, 2, 3, 3, 3, 4, 5, 4$$

find the future values by using the model

$$X(n + 1) = c(0)X(n) + c(1)X(n\text{-}1) + c(2)X(n\text{-}2)$$

Use the autocorrelation function approach.

12. Among 8 coins, one is known to be lighter than the others. Find the minimum number of weighing required to find the light coin.