1. Give the ASN.1 encoding for the following three integers. Note that ASN.1 integers, like those in XDR, are 32 bits in length.
   (a) 101
   (b) 10,120
   (c) 16,909,060
2. Give the big-endian and little-endian representation for the integers from the exercise above.
3. The presentation-formatting process is sometimes regarded as an autonomous protocol layer, separated from the application. If this is so, why might including data compression in the presentation layer be a bad idea?
4. Let $p \leq 1$ be the fraction of machines in a network that are big endian; the remaining $1 - p$ fraction are little-endian. Suppose we choose two machines at random and send an `int` from one to the other. Give the average number of byte-order conversions needed for both big-endian network byte order and receiver-makes-right or both for $p = 0.1$, $p = 0.5$, and $p = 0.9$. (Hint: The probability that both endpoints are big-endian is p^2; the probability that the two endpoints use different byte orders is $2p(1 - p)$.)
5. Suppose a file contains the letters a, b, c, and d. Nominally we require 2 bits per letter to store such a file.
   (a) Assume the letter a occurs 50% of the time, b occurs 30% of the time , and c and d each occurs 10% of the time. Give an encoding of each letter as a bit string that provides optimal compression. (Hint: construct a Huffman code)
   (b) What is the percentage of compression you achieve above?
   (c) Repeat this, assuming a and b each occur 40% of the time, c occurs 15% of the time and d occurs 5% of the time.
6. The one-dimensional discrete cosine transform is similar to the two-dimensional transform, except that we drop the second variable (j or y) and the second cosine factor. We also drop, from the inverse DCT only, the leading $1/\sqrt{2}N$ coefficient. Implement this and its inverse for $N = 8$ (spreadsheet or Matlab will do) and answer the following:
   (a) If the input data is $\{1, 2, 3, 5, 5, 3, 2, 1\}$, which DCT coefficients are near 0?
   (b) If the data is $\{1, 2, 3, 4, 5, 6, 7, 8\}$, how many DCT coefficients must we keep so that after the inverse DCT tha values are all within 1% of their original values? 10%? Assume dropped DCT coefficients are replaced with 0s.
   (c) Let s_i, for $1 \leq i \leq 8$, be the input sequence consisting of a 1 in position i and 0 in position $j \neq 1$. Suppose we apply the DCT to s_i, zero the last three coefficients, and then apply the inverse DCT. Which $i, 1 \leq i \leq 8$, results in the smallest error in the ith place in the result? The largest error?
7. Compare the size of an all-white image in JPEG format with a typical photographic image of the same dimensions. At what stage or stages of the JPEG compression process does the white image become smaller than the photographic image?
8. Suppose you want to implement fast-forward and reverse for MPEG streams. What problems do you run into if you limit your mechanism to displaying I frames only? If you don't, then to display a given frame in the fast-forward sequence, what is the largest number of frames in the original sequence you may have to decode?