1a: In quicksort, at an intermediate stage of the algorithm, you choose the key 50 in the following list.

1, 3, 7, 10, 11, 15, 18, 23, 25, 50, 39, 37, 31, 55, 77, 80, 87, 82, 84, 90, 97

where you are currently working on the sublist between 25 and 80. What happens in the rest of this stage of the algorithm?

1b: In quicksort, if you are unlucky in your random choice of numbers, the algorithm can take $O(n^2)$. What kind of bad choices do you have to make to be unlucky?

2: For the sequence of frequencies

1, 4, 1, 2, 2, 1, 1, 4

Construct a tree giving a Huffman code for this set of frequencies. Construct the Hu-Tucker tree for this set of frequencies. Find the length of the encoding in each of these cases for a sequence having this set of letter frequencies.

3: For the sequence

01011011110101111101110111

construct the Lempel-Ziv parsing of it. How would it be encoded by the Lempel-Ziv code?

4: For the primitive polynomial $p(x) = 1 + x + x^3$, construct the remainder table relating $x^k$ and its remainder when divided by $p(x)$. Use this to compute $p_3(x)$. For a two-error correcting code using this polynomial, what would you multiply $m(x)$ by to encode? How many bits will this error-correcting code encode?