

7 Information Theory (rkh23)

- (a) Show how to use Huffman coding to produce optimal *ternary* codewords for a symbol alphabet of size 9 with a uniform probability distribution across the input symbols. Explain how you know it is optimal. [3 marks]
- (b) A *suffix* code occurs when no codeword is a suffix of any other codeword. For example, 01 precludes 101. Show that an optimal suffix code exists for every probability distribution over the input symbols. [3 marks]
- (c) An alternative code assigns a codeword of exact length $\lceil \log_2(\frac{1}{P_i}) \rceil$ to symbol i , which occurs with probability P_i .
- (i) Explain the significance of $\lceil \log_2(\frac{1}{P_i}) \rceil$ and the logic behind its use in this way. [2 marks]
- (ii) Can this scheme always produce a prefix code? Justify your answer. [2 marks]
- (iii) Compare this scheme to a Huffman code. [5 marks]
- (d) If *all* symbols input to a Huffman code occur with probability $< p$ there can be no codeword of length 1. Find the upper bound for p . [5 marks]