

1. (a) In a compression scheme, a data source consists of eight symbols, with the probability distribution given in Table 1.

在压缩方案中，数据源由8个符号组成，其概率分布如表1所示。

Table 1

Symbol	S ₀	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇
Probability of occurrence	0.02	0.05	0.08	0.10	0.14	0.16	0.19	0.26

- (i) Design a suitable set of Huffman codewords for the eight symbols. Clearly show all the key steps and calculations.

为这八个符号设计一套合适的霍夫曼码字。

清楚地显示所有的关键步骤和计算。

(8 Marks)

- (ii) A student originally uses 8 bits to represent each symbol in an uncompressed scheme. Find the compression ratio of the Huffman coding scheme developed in part (i) when compared with the original uncompressed scheme.

(ii) 学生最初使用8位来表示未压缩方案中的每个符号。

找出第(1)部分开发的霍夫曼编码方案与原始未压缩方案相比的压缩比。

(6 Marks)

- (iii) Find the entropy of the data source. Briefly discuss whether it is possible to design a codeword set which can achieve a target of less than 2.5 bits/symbol.

(iii) 求数据源的熵。

简要讨论了是否有可能设计一个码字集，以达到低于2.5位/符号的目标。

(5 Marks)

- (b) Draw a simple block diagram of the baseline JPEG decoder. Clearly label all the key components in the diagram.

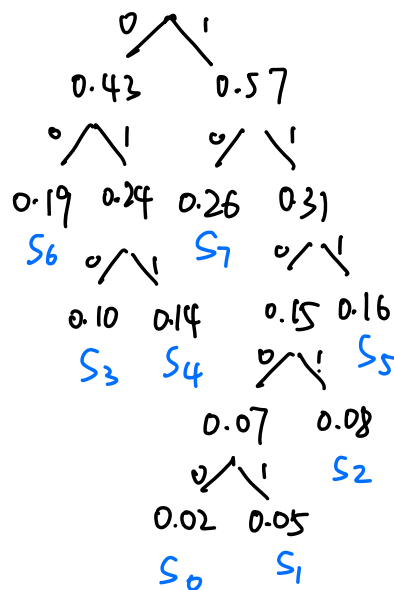
(b) 绘制基线JPEG解码器的简单框图。

清楚地标记图表中的所有关键组件。

(6 Marks)

Q: (i) Huffman

Solution


$$\begin{array}{cccc}
 S_7 & 1 & 0 & \\
 S_6 & 0 & 0 & \\
 S_5 & 1 & 1 & 1 \\
 S_4 & 0 & 1 & 1 \\
 S_3 & 0 & 1 & 0 \\
 S_2 & 1 & 1 & 0 \quad) \\
 S_1 & 1 & 1 & 1 \quad 0 \quad) \\
 S_0 & 1 & 1 & 1 \quad 0 \quad 0
 \end{array}$$
$$R_{a-fs} = 2 \times (0.26 + 0.19) + 3 \times (0.16 + 0.14 + 0.10)$$

$$+ 4 \times 0.08 + 5 \times (0.05 + 0.02) = 2.77 < 8$$

the Huffman codebook compression ratio

is better $\text{ratio} = \frac{\text{un compressed scheme}}{\text{compressed scheme}}$

$$= \frac{8}{2.77} = 2.882$$

(iii) entropy $< 2.5 \text{ bits/symbol?}$

$$\eta = H(S) = \sum_{i=1}^n p_i \log_2 \frac{1}{p_i} = - \sum_{i=1}^n p_i \log p_i$$

$$= - \left[0.02 \log_2 0.02 + 0.05 \log_2 0.05 + \dots + 0.28 \log_2 0.28 \right]$$

$$= 2.7333$$

No way, due to code word compression ratio will not less than entropy

Exercise JPEG 编码器

Q: 框图

Solution

