(a) (i) To design a set of Huffman codewords:

C: 0.20 → 0.20 → 0.20 ↗ 0.30 → 0.30 ↗ 0.40 ↗ 0.60 (1)

D: 0.15 → 0.15 ↗ 0.20 ↗ 0.20 ↗ 0.30 ↘ 0.30 (1) ↘ 0.40 (0)

E: 0.15 → 0.15 ↗ 0.15 ↗ 0.20 ↗ C (1) 0.20 ↗ (0) 0.30

F: 0.15 → 0.15 ↗ 0.15 ↗ D (1) 0.15 ↗ (0) 0.20

B: 0.10 ↗ 0.15 ↗ F (1) 0.15 ↘ Ē (0) 0.15

G: 0.10 ↗ B (1) 0.10 ↗ (0) 0.15

H: H (1) 0.10 ↗ G (0) 0.10

A: A (0) 0.05
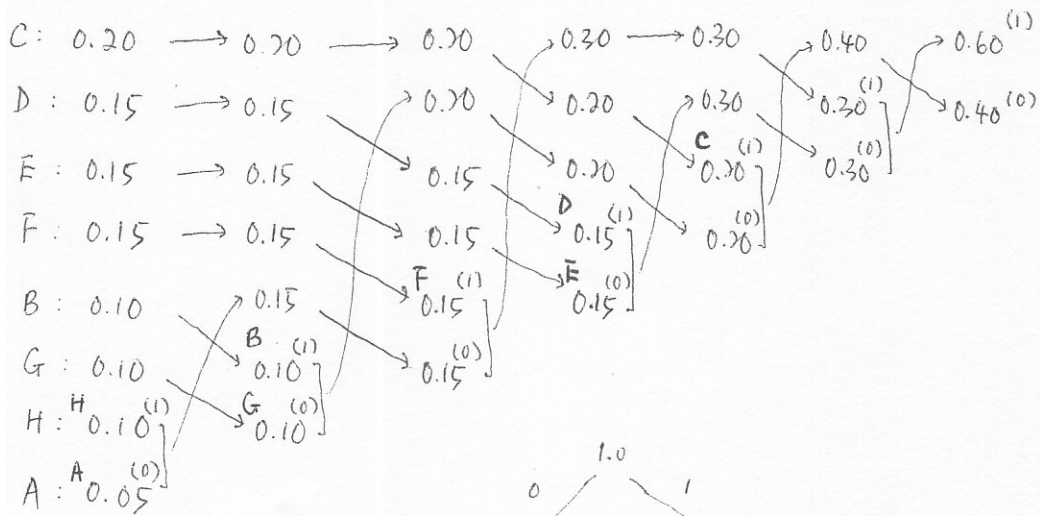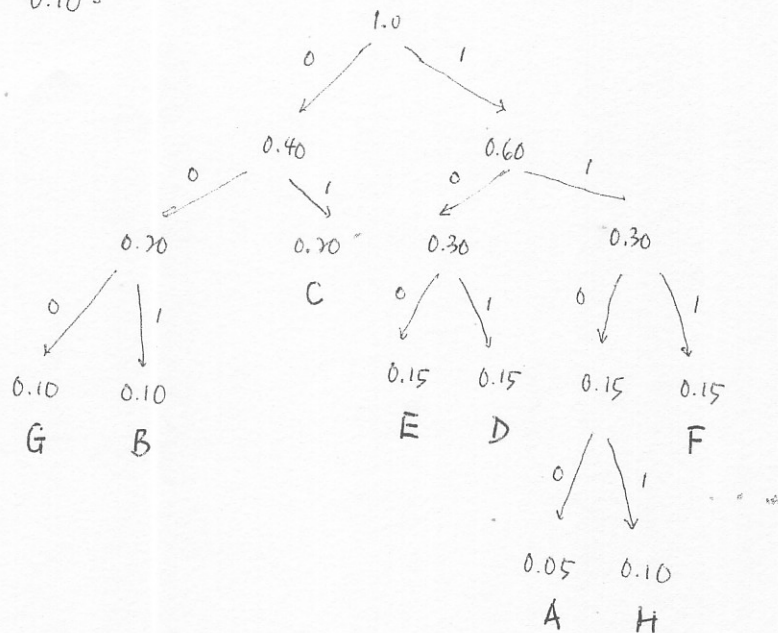
Huffman Codetree:

Huffman codeset

A: 1100

B: 001

C: 01

D: 101

E: 100

F: 111

G: 000

H: 1101

Compression ratio:

$$= \frac{\text{data requirment for uncompressed data}}{\text{"} \quad \text{"} \quad \text{"} \quad \text{compressed data}}$$

Message X :

- uncompressed scheme : $8 \times 3 = 24$ bits

- compressed scheme : $3 + 2 + 2 + 3 + 3 + 3 + 3 + 3$

$$= 22 \text{ bits}$$

Compression ratio $= \frac{24}{22} = 1.09$

Message y :

- uncompressed scheme : $8 \times 3 = 24$ bits
- compressed scheme = $4 + 3 + 4 + 2 + 3 + 4 + 4 + 3$

$$= 27 \text{ bits}$$

Comp. ratio

$$= \frac{24}{27} = 0.89$$