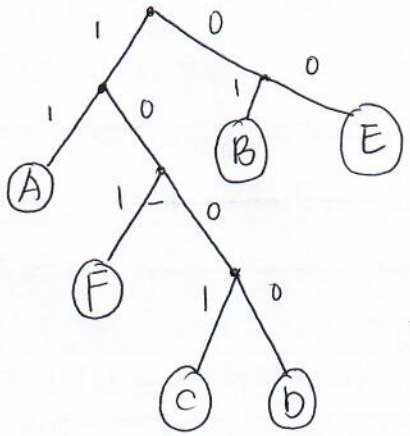
[12] Consider the data file consisting of 6 symbols A ~ F: AAFBECCAFFEBAADEBABE

1 (a) Find the 1st ordering of the symbols in the **decreasing order of the effective probabilities**. [2 pts]

Symbol	A, X_0	B, X_1	C, X_2	D, X_3	E, X_4	F, X_5
Effective probability	$\frac{6}{20}$	$\frac{4}{20}$	$\frac{2}{20}$	$\frac{1}{20}$	$\frac{4}{20}$	$\frac{3}{20}$
	=0.3	=0.2	=0.1	=0.05	=0.2	=0.15

4 (b) Find the **binary tree for Huffman coding** to compress this file. [4 pts]



A 0.3
B 0.2
E 0.2
F 0.15
C 0.1 [1]
D 0.05 [0]

→ A 0.3 / B 0.2 / E 0.2 / F 0.15 [1] / C-D 0.15 [0]

→ B-E 0.4 / A 0.3 [1] / F-C-D 0.6 [1] / B-E 0.4 [0]

→ A 0.3 / F-C-D 0.3 / B 0.2 [1] / E 0.2 [0]

2 (c) Find the code words of the symbols. [2 pts]

2 (d) Compute the **effective source entropy** and the **average number of bits** per symbol. [4 pts]

(c) Table of Codewords

Symbol	Codeword
A	11
B	01
C	~~00~~ 1001
D	1000
E	00
F	101

(d)-1 Effective source entropy

$$H_S = -\sum_{i=0}^{6-1} P[X_i] \log_2 P[X_i]$$

$$= -0.3\log_2 0.3 - 0.2\log 0.2 - 0.1\log_2 0.1 - 0.05\log_2 0.05$$

$$-0.2\log_2 0.2 - 0.15\log 0.15 = 2.40869 \text{ bits/symbol}$$

~~bit~~.

(d)-2 Average number of bits

2bit인 A가 6개, 2bit인 B가 4개 4bit인 C가 2개,
4bit인 D가 1개, 2bit인 E가 4개, 3bit인 F가 3개
일때 Average number of bits은

$2\times6 + 2\times4 + 4\times2 + 4\times1 + 2\times4 + 3\times3 = 49$ bits이다.