1.

a) $\begin{bmatrix} 235.045 \\ 128 \\ 128 \end{bmatrix}$

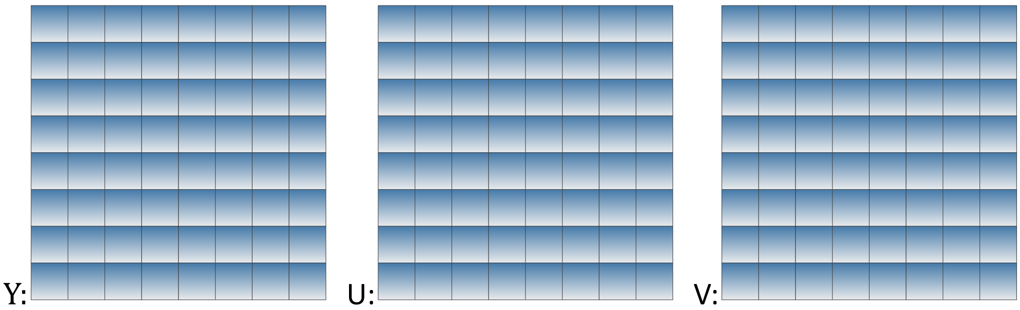
b) $\begin{bmatrix} 145.52 \\ 53.79 \\ 34.165 \end{bmatrix}$

c) $\begin{bmatrix} 210.055 \\ 16.055 \\ 146.105 \end{bmatrix}$

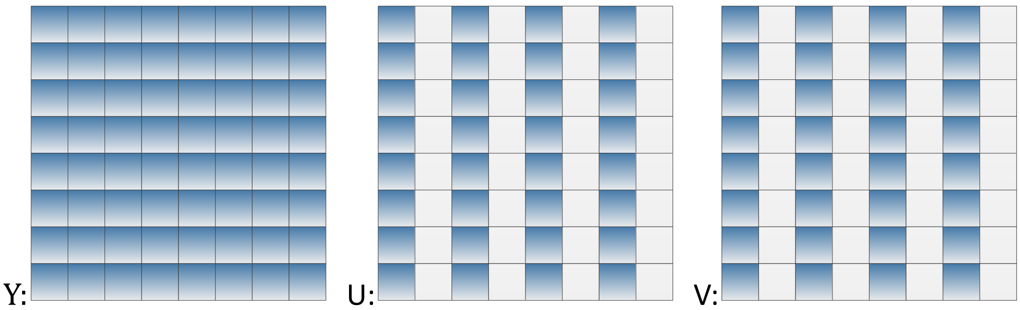
d) $\begin{bmatrix} 93.056 \\ 146.944 \\ 71.808 \end{bmatrix}$

2. Use 8x8 as example for diagrams. The dark block is sampled data.

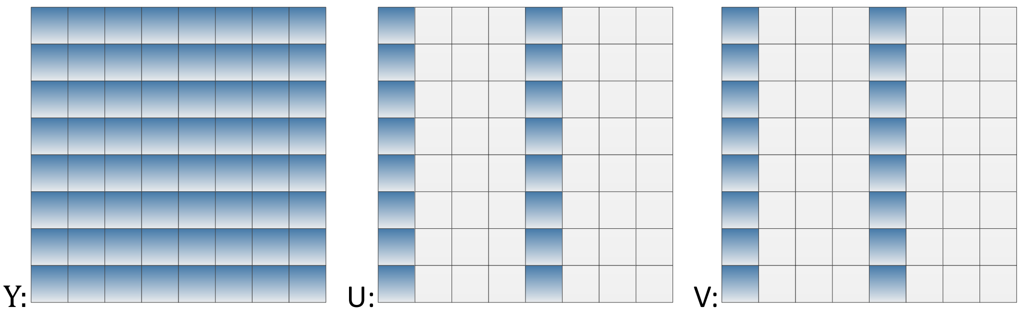
a) 4:4:4 means Y, U, V are sampled as original data.



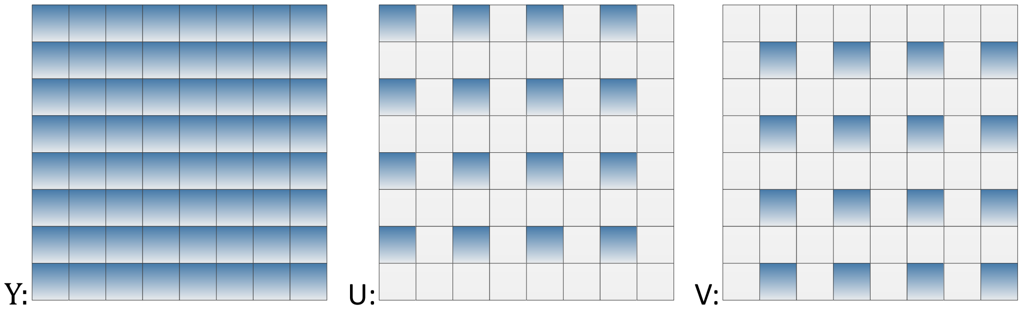
b) 4:2:2 means U, V are sampled as half of original data.



c) 4:1:1 means U, V are sampled as quarter of original data.



d) 4:2:0 means U is sampled as quarter of original data for each ODD rows and V is sampled as quarter of original data for each EVEN rows.



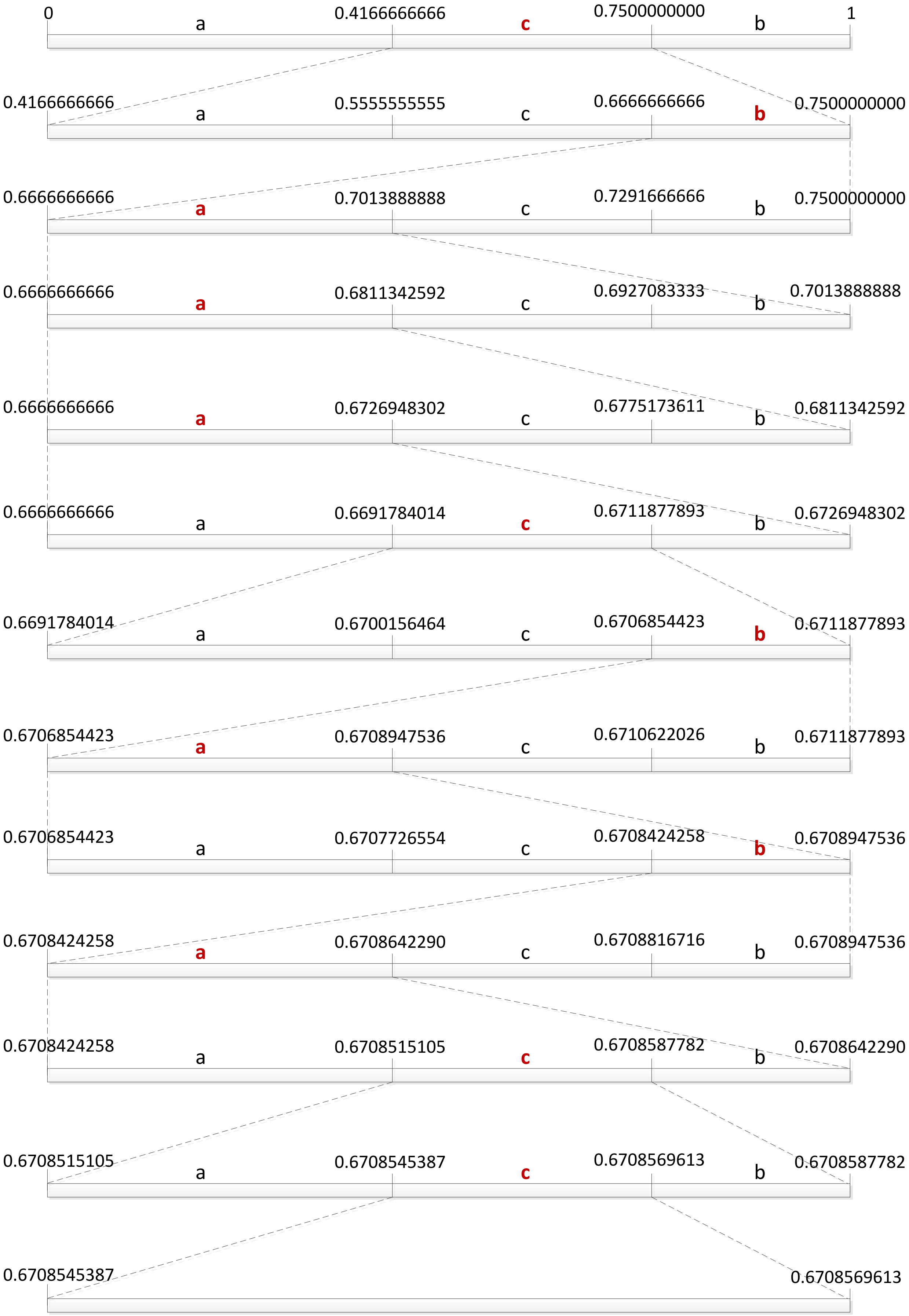
3. **Profile** identifies subset of features to be implemented.
   Level indicates encoding computation complexity.
4. Temporal scalability: Frame-rate
   Spatial scalability: Resolution
   SNR scalability: Quality
5. Drifting is propagating the error for future frame when intra-frame prediction is used.
   Use smaller GOP size and reduce the number of B and P frame.
6. Start code is used for stream-oriented to set the boundary for each video sub-stream.
7. $\mathrm{H(s)} = \sum_i p_i \log_2\left(\frac{1}{p_i}\right)$

   a) $p_i = \frac{1}{L} \Longrightarrow \mathrm{H(s)} = \sum_i \frac{1}{L} \log_2(L) \Longrightarrow \log_2(L)$

   b) $p_a = 1, p_x = 0, \mathrm{a} \neq \mathrm{x} \Longrightarrow \mathrm{H(s)} = p_a \log_2(1) + \sum_{\mathrm{a} \neq \mathrm{x}} p_x \log_2(0) \Longrightarrow 0$
8. a:5, b:3, c:4 $\rightarrow$ sort by frequency: b= $\frac{3}{12}$, c= $\frac{4}{12}$, a= $\frac{5}{12}$ and set decimal point to ten digits.

   Assume each symbol encoded with two bits. Total bits is 2*12 = 24 bits.

Encode by Arithmetic coding:



Decode by Arithmetic coding:

Assume output value is 0.6708545387

Falls in c's interval $\rightarrow$ **output: c**

$\frac{0.6708545387-0.4166666666}{\frac{4}{12}} = 0.7625636163$ falls in b's interval $\rightarrow$ **output: b**

$\frac{0.7625636163-0.7500000000}{\frac{3}{12}} = 0.0502544652$ falls in a's interval $\rightarrow$ **output: a**

$\frac{0.0502544652-0.0000000000}{\frac{5}{12}} = 0.1206107164$ falls in a's interval $\rightarrow$ **output: a**

$\frac{0.1206107164-0.0000000000}{\frac{5}{12}} = 0.2894657193$ falls in a's interval $\rightarrow$ **output: a**

$\frac{0.2894657193-0.0000000000}{\frac{5}{12}} = 0.6947177263$ falls in c's interval $\rightarrow$ **output: c**

$\frac{0.6947177263-0.4166666666}{\frac{4}{12}} = 0.8341531791$ falls in b's interval $\rightarrow$ **output: b**

$\frac{0.8341531791-0.7500000000}{\frac{3}{12}} = 0.3366127164$ falls in a's interval $\rightarrow$ **output: a**

$\frac{0.3366127164-0.0000000000}{\frac{5}{12}} = 0.8078705193$ falls in b's interval $\rightarrow$ **output: b**

$\frac{0.8078705193-0.7500000000}{\frac{3}{12}} = 0.2314820772$ falls in a's interval $\rightarrow$ **output: a**

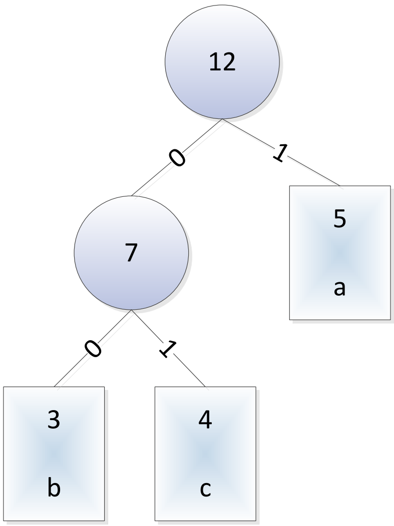
$\frac{0.2314820772-0.0000000000}{\frac{5}{12}} = 0.5555569852$ falls in c's interval $\rightarrow$ **output: c**

$\frac{0.5555569852-0.4166666666}{\frac{4}{12}} = 0.4166709558$ falls in c's interval $\rightarrow$ **output: c**

$\frac{0.4166709558-0.4166666666}{\frac{4}{12}} \approx 0$, Done

Output: **c, b, a, a, a, c, b, a, b, a, c, c**

Encode by Huffman coding:



a: 1

b: 00

c: 01

cbaaacbabacc → 0100111010010010101 (Total 19 Bits)