9. Write down an algorithm (pseudocode) for calculating a color histogram for RGB data.

```
for x in range(0, MAX_Y):
    for y in range(0, MAX_X):
        R = image[x][y].red
        G = image[x][y].green
        B = image[x][y].blue
        histogram[R][G][B] += 1
```

7. Repeat the steps leading up to eq.(4.18), but this time using the NTSC standard — if you use the number of significant digits as in Table 4.1 you will end up with the transform in eq.(4.19).

对于 NTSC 标准，有 $(x, y, z) = (0.3101, 0.3162, 0.3737)$，或者除以中间值，$XYZ_{white} = (0.9807, 1, 1.18185)$。$D = diag(d_1, d_2, d_3)$

$$XYZ_{white} = MD(1, 1, 1)^T$$

$$\Leftrightarrow \begin{bmatrix} 0.9807 \\ 1 \\ 1.18185 \end{bmatrix} = \begin{bmatrix} 0.67 & 0.21 & 0.14 \\ 0.33 & 0.71 & 0.08 \\ 0 & 0.08 & 0.78 \end{bmatrix} \begin{bmatrix} d_1 \\ d_2 \\ d_3 \end{bmatrix}$$

$$\therefore (d_1, d_2, d_3) = (0.9059, 0.8262, 1.4305)$$

$$T = MD = \begin{bmatrix} 0.607, & 0.174, & 0.200 \\ 0.299, & 0.587, & 0.114 \\ 0.000, & 0.066, & 1.116 \end{bmatrix}$$

$$\therefore \begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = T \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

$$\therefore \begin{aligned} X &= 0.607 \cdot R + 0.174 \cdot G + 0.200 \cdot B \\ Y &= 0.299 \cdot R + 0.587 \cdot G + 0.114 \cdot B \\ Z &= 0.000 \cdot R + 0.066 \cdot G + 1.116 \cdot B \end{aligned}$$

9. What is the advantage of interlaced video? What are some of its problems?

优点：减少闪动
缺点：运动模糊

11. Assuming the bit-depth of 12 bits, 120 fps, and 4:2:2 chroma subsamplng, what are the bitrates of the 4K UHDTV and 8K UHDTV videos if they are uncompressed?

∵ 4:2:2, Y占12 bits, C_b/C_r占12 bits

4K UHDTV: $3840 \times 2160 \times 120 \times 2 \times 12 \approx 23.89\text{Gbps}$

8K UHDTV: $7680 \times 4320 \times 120 \times 2 \times 12 \approx 95.57\text{Gbps}$

2. My old Soundblaster card is an 8–bit card.

   (a) What is it 8 bits of?

   (b) What is the best SQNR (Signal to Quantization Noise Ratio) it can achieve?

(a) 量化率

(b) $SQNR = 20\log_{10}\frac{V_{signal}}{V_{quan\_noise}} \approx 20\log_{10}\frac{2^{8-1}}{\frac{1}{2}} \approx 48\text{dB}$

9. Suppose the dynamic range of speech in telephony implies a ratio V_{max}/V_{min} of about 256. Using uniform quantization, how many bits should we use to encode speech, so as to make the quantization noise at least an order of magnitude less than the smallest detectable telephonic sound?

$\frac{2V_{max}}{2^N} = \text{量化噪声} < 0.1V_{min}$

$N \geq 12$

∴ 12

15. Suppose a signal contains tones at 1 kHz, 10 kHz, and 21 kHz, and is sampled at the rate 12 kHz (and then processed with an anti-aliasing filter limiting output to 6 kHz). What tones are included in the output?
Hint: most of the output consists of aliasing.

1 kHz

12 kHz − 10 kHz = 2 kHz

2 × 12 kHz − 21 kHz = 3 kHz