Partiel 2015-2016

Tuesday, October 28, 2025 9:13 AM

Exercise 1

1. size of 1 image = $720 \times 576 \times 1$ (1 bit black/white)
$= 414720$ bits

10 seconds x 2 Mbits/s
↳ in 10 seconds, I can send
20 Mbits

↳ $\frac{20}{0.41472} = 48$ images

2. size of 1 image = $720 \times 576 \times 8$ (256 levels $\Rightarrow 2^8$)
$= 3\,294\,720$ bits

$$\frac{20}{3.29472}$$

3. avg bits per pixel $= \frac{4 \times 8 + 8 + 8}{4}$ (4:2:0 sampling)

per pixel $= 12$

Number of complete images sent $= \dfrac{20}{0.41472 \times 12} = 4.018$

$0.41472 = \dfrac{720 \times 576}{10^6}$

$\Rightarrow$ 4 images

Exercise 2 :

1. $p(0) = 32/64 = 0.5$

$p(50) = 16/64 = 0.25$

$p(20) = p(99) = 8/64 = 0.125$

Entropy : $-\sum p_i \log_2(p_i)$

$= -(0.5 \log_2(0.5) + \dots$

$= 1.75$

2. grayscale ⟹ 8 bits

$$\text{efficiency} = \frac{1.75}{8} = 0.21875$$
$$= 21.9\%$$

3- <8, 99> <8, 20> <10, 0>
<4, 50> <4, 0> <4, 50>
<4, 0> <4, 50> <4, 0>
<4, 50> <10, 0>

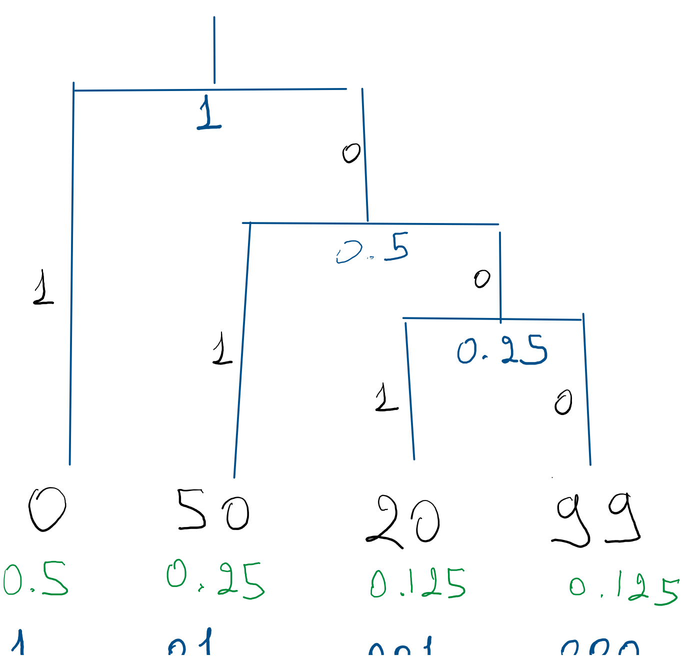
we have 11 runs

we need 14 bits per run (8 + 6) (8: pixel size; 6: 64 max)

compressed size = 11 × 14 = 156 bits

$$\text{compression ratio} = \frac{\text{original}}{\text{new}} = \frac{64 \times 8}{156} \approx 3.33 : 1$$

4-



0.5	0.25	0.125	0.125
1	01	001	000

5- avg bits per symbol $= 0.5 \times 1 + 0.25 \times 2 + 0.125 \times 3 + 0.125 \times 3$

$= 1.75$

efficiency: $\frac{1.75}{1.75} = 1 = 100\%$

6-a- 2 bits → 2 bits, so:

0: 00 / 20: 01 / 50: 10 / 99: 11

probabilities are unchanged.

Entropy = 1.75 bits/pixel

b- would not change

Exercise 3

a b b a c c c a b c

<97> <98> <98> <97> <99> <260> <256> <99>

Symbol	Code
a	97
b	98
c	99
ab	256
bb	257

ab	256
bb	257
ba	258
ac	259
cc	260
cca	261
abc	262

2- 97 98 256 97 99 259 97
a b ab a c ac a

Symbol	Code
a	97
b	98
c	99
ab	256
ba	257
aba	258
ac	259

Exercise 4:

pixel$_{0,0}$ = 128 > 127

↳ 255, error = 128 − 255
= −127

we apply the error dithering

	X	7/16
3/16	5/16	1/16

× −127

⇒ $-127 \times \frac{7}{16} = -55$ we add this value to pixel P$_{0,1}$

⇒ 64 − 55 = 8

to pixel 1

=> 64 - 55 = 8

after the first pixels

255	8	—	—
88	24	—	—
—	—	—	—
—	—	—	—