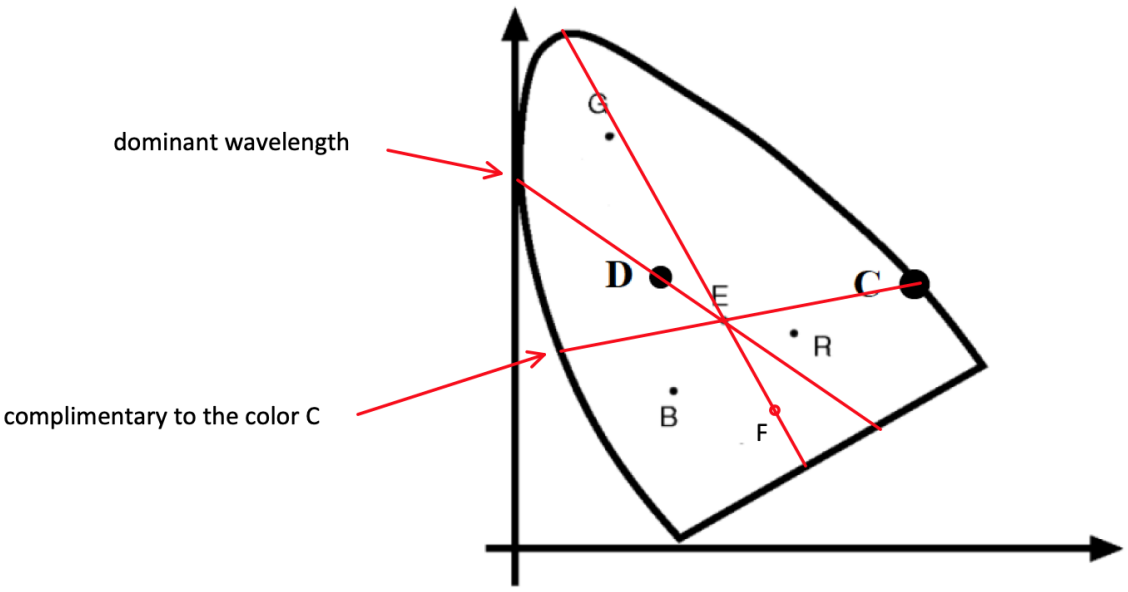
Q1



2) No, for example, the color at F doesn't have a complimentary color

3) White color is mapped with the equiluminous point E

Q2

1)

$$x = \frac{X}{X+Y+Z} \quad ①$$

$$y = \frac{Y}{X+Y+Z} \quad ②$$

$$z = \frac{Z}{X+Y+Z} = 1 - x - y \quad ④$$

$$① \Rightarrow X = (X+Y+Z)x \quad ③$$

$$④ \Rightarrow Z = (1-x-y)(X+Y+Z)$$
$$= (1-x-y)\frac{X}{x}$$

$$② \Rightarrow X+Y+Z = \frac{Y}{y} \quad ⑤$$

$$⑤ ③ \Rightarrow X = \frac{Y}{y}x \Rightarrow \frac{X}{x} = \frac{Y}{y} \quad ⑥$$

$$⑥ ④ \Rightarrow Z = (1-x-y)\frac{Y}{y}$$
$$= [(1-x-y)/y]Y$$

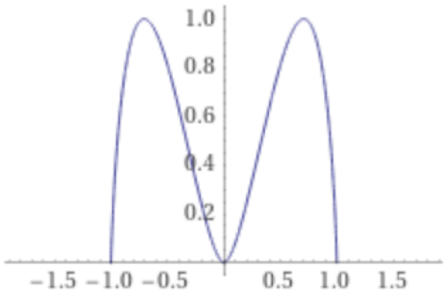
2) No, because print colors are reflection from the light source. So its color depends on the spectrum in the light source. Same print under different light sources will not appear the same. So in this algorithm, it didn't say under what kind of light source.

3) A real image with varying color tones. Because it contains more color. So we can compare more colors between them.

4) Test with pictures that do not have high saturation value, with not so vivid colors. Use a light source that has a wide spectrum.

Q3

1) $H = -x^2 \log_2 x^2 - (1-x^2) \log_2 (1-x^2)$



2) At $x = 0$ or $x = 1$, has minimum entropy

At $x = \frac{1}{\sqrt{2}}$, it has maximum entropy

3) $\frac{dH}{dx} = \frac{2x(\log(1-x^2) - \log(x^2))}{\log(2)}$

find x when $\frac{dH}{dx} = 0$

$$\log(1-x^2) - \log(x^2) = 0$$
$$1-x^2 = x^2$$
$$x = \frac{1}{\sqrt{2}}$$

So when $x = \frac{1}{\sqrt{2}}$, it has maximum entropy

4) find x when $\frac{dH}{dx} = 0$

$2X = 0$

$X = 0$

When $P(X) = 1$, $P(Y) = 0$ or $P(X) = 0$, $P(Y) = 1$, it has minimum entropy. Because all informations are the same.

$X^2 = 0$ or $1 - X^2 = 0$

$X = 0$

So when $X = 0$, it has minimum entropy.

Q4

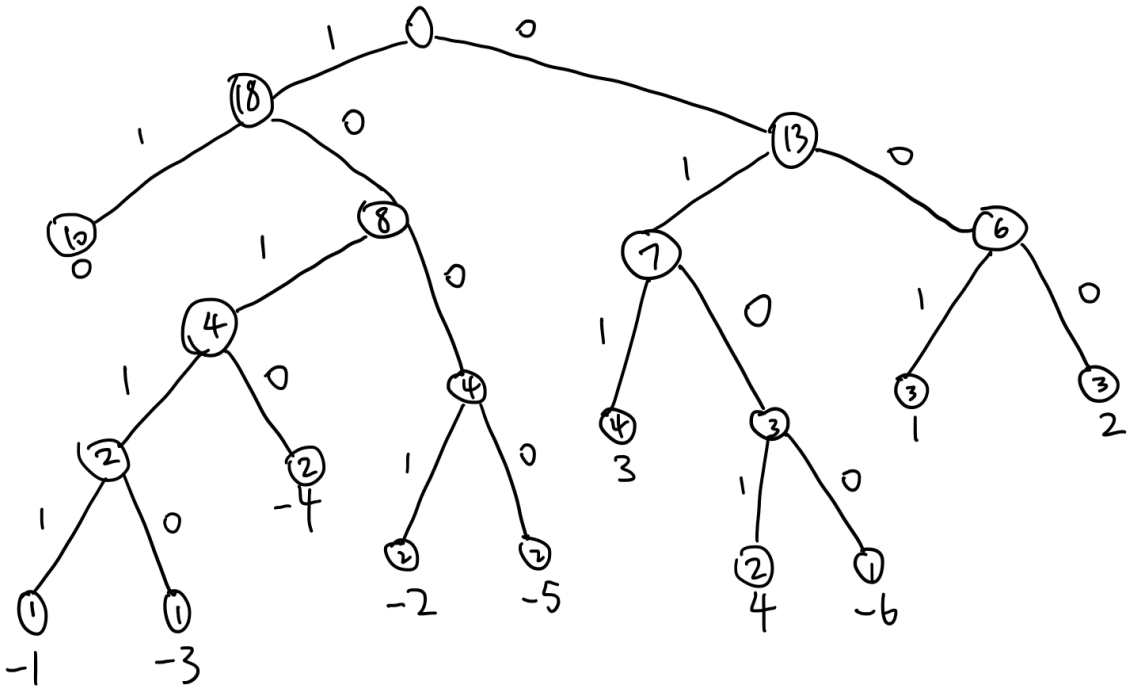
1) 22, 24, 24, 28, 28, 28, 25, 26, 26, 26, 21, 19, 20, 20, 22, 24, 24, 24, 23, 24, 20, 16, 10, 10, 8, 11, 6, 9, 9, 12, 15, 19

2) To represent 32 levels, you need 5 bits. So totally 32 samples need 32 * 32 = 1,024 bits

3) After encoding with DPCM, the sequence will be 2, 0, 4, 0, 0, -3, 1, 0, 0, -5, -2, 1, 0, 2, 2, 0, 0, -1, 1, -4, -4, -6, 0, -2, 3, -5, 3, 0, 3, 3, 4.
The maximum is 4, minimum is -6
To represent -6 to 4, which is 11 levels, you need 4 bits. So totally 31 values in the sequence need 31 * 4 = 124 bits

4) Compression ratio = (31*5) / (31*4) = 1.25

5) Count(0) = 10 ✓
Count(3) = 4 ✓
Count(2) = 3 ✓
Count(1) = 3 ✓
Count(4) = 2 ✓
Count(-2) = 2 ✓
Count(-4) = 2 ✓
Count(-5) = 2 ✓
Count(-1) = 1 ✓
Count(-3) = 1 ✓
Count(-6) = 1 ✓



2 -> 000
1 -> 001
-6 -> 0100
4 -> 0101
3 -> 011
-5 -> 1000
-2 -> 1001
-4 -> 1010
-3 -> 10110
-1 -> 10111
0 -> 11

6) 2: 3*3=9 , 0: 10*2=20 , 4: 2*4=8 , -3: 1*3=3 , 1: 3*3=9 , -5: 2*4=8 , -2: 2*4=8 , -1: 1*5=5 , -4: 2*4=8 , -6: 1*4=4 , 3: 4*3=12
Total bits = 9+20+8+3+9+8+8+5+8+4+12=94 bits

7) Compression ratio = (31*5) / 94 = 1.6489