

Exercise Computer graphics – (till October 19, 2007)

Bi-level display of gray-images

Exercise 10: (a) The following pattern is given for gray-level approximation:

```
16  5  6  7
15  4  1  8
14  3  2  9
13 12 11 10
```

A tiny image of 2x2 pixels is to be rendered using the above pattern. However, it is allowed to increase the resolution of the result by the factor of 4 for every side resulting in an output image of 8x8. Which pixels will be set in the output?

```
1  8
12 4
```

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Exercise 10: (b) This time the 8x4 image below is to be rendered using the same pattern as before. However, the image size of 8x4 should be preserved using the modulo-technique. The rule is that a pixel will be set if the value in the pattern is smaller or equal to the gray level which should be displayed.

Hint:

In the modulo-version of the black & white rendering approach, we first calculate the modulo of both the x- and the y-coordinate of a pixel. The result then addresses a grid in the pattern. We actually set the pixel only, if the value within the grid is smaller or equal to the gray-value to be rendered.

Example: We want to render gray value 11 of pixel (6, 3) [first cell is (0,0)]. The corresponding grid-cell in the pattern is $(6 \% 4, 3 \% 4) = (2, 3)$. The grid-cell (2, 3) of the pattern is 11. Since $11 \leq 11$ we set the pixel.

Image:

10	4	12	12	10	6	3	7
10	5	12	12	6	15	9	11
8	9	12	12	12	4	10	15
9	10	1	0	1	5	11	1

Solution should look like this:

?	?	?	?	?	?	?	?
?	?	?	?	.	?	?	?
?	*	?	?	?	?	?	?
?	?	?	?	?	?	*	?

pixel set = *
 pixel clear = .
 fill in yourself = ?

Pattern:

16	5	6	7
15	4	1	8
14	3	2	9
13	12	11	10

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Exercise 10: (c) In exercise (a), each gray-value to be rendered is mapped to a dithering pattern. It is easy to imagine that this does not alter the mean gray value of the B/W image as compared to the original gray image.

Is this also true for exercise (b)?

Exercise 11: Alter the Floyd-Steinberg dithering such that it generates colored dithered images. Use a very limited palette, only.