

5/26 画像信号処理特論

Schedule

- 5/12 “Hello World!” of image processing
- 5/19 Image filtering
- 5/26 Binarization
- 6/2 (Prof. Tehrani)
- 6/9 (Prof. Tehrani)
- 6/16 (Prof. Tehrani)
- 6/23 Histogram ← 1st report deadline
- 6/30 Discrete Cosine Transform
- 7/7 JPEG
- 7/14 (Prof. Fujii) ← 2nd report deadline
- 7/21 (Prof. Fujii)

Today's issue

- Binarization (simple thresholding)



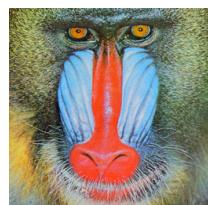
input



output

Today's issue

- Binarization (simple thresholding)



input



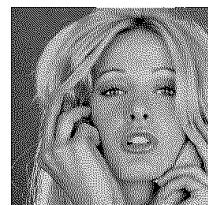
output

Today's issue

- Binarization (with error diffusion)



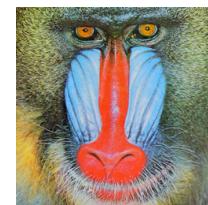
input



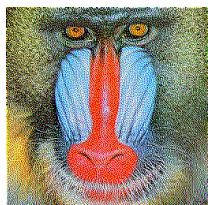
output

Today's issue

- Binarization (with error diffusion)



input



output

Binarization

- Threshold the pixel values

```
For all pixels (x,y)
    value = I(x,y);
    if value > thres
        O(x,y)=255
    else
        O(x,y)=0
```

Binarization

- Advantage
 - Compact representation
- Disadvantage
 - Lose much information
- A remedy for information loss
 - Error diffusion
 - A.K.A. half-toning or dithering

Error diffusion

- Thresholding error at a pixel is propagated (*carried over*) to the next pixels.
- Wide range of applications
 - Image printing
 - Putting a drop of ink or not for each dot
 - Display
 - Less quantization accuracy than the original image
 - Image compression
 - Reducing the color palette

Error diffusion

- Propagate the thresholding error to next pixels

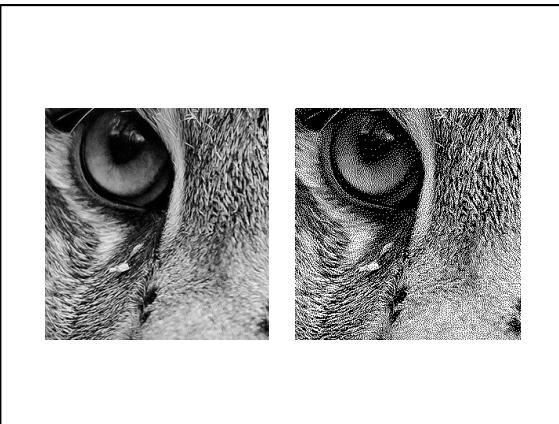
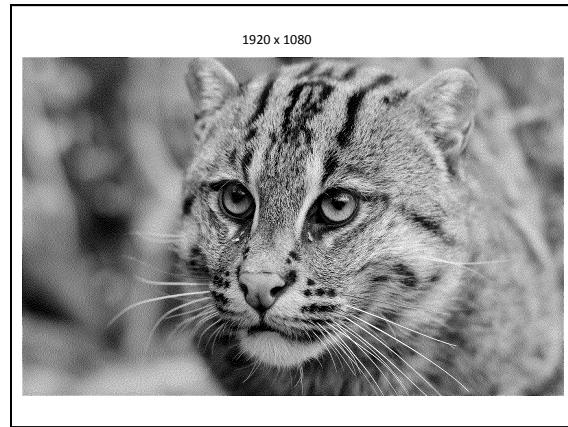
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*	*	Cur	7/16	
	3/16	6/16	1/16	

Procedure of error diffusion

```
For all pixels (x,y)
    int value = I(x,y);
    if value > thres    // apply thresholding
        O(x,y)=255;
    else
        O(x,y)=0;
    err = O(x,y) - I(x,y)    // thresholding error
```

Procedure of error diffusion

```
For all pixels (x,y)
...
err = I(x,y) - O(x,y)    // thresholding error
// error propagation
I(x+1, y ) += k1*err;
I(x+1, y+1) += k2*err;
I(x , y+1) += k3*err;
I(x+1, y+1) += k4*err;
```



Exercises

- Implement binarization with a fixed threshold
 - Test several different threshold values and compare the results
 - How can you optimize the threshold value?
- Implement binarization with error diffusion
 - Why is the original appearance of an image preserved with this method?