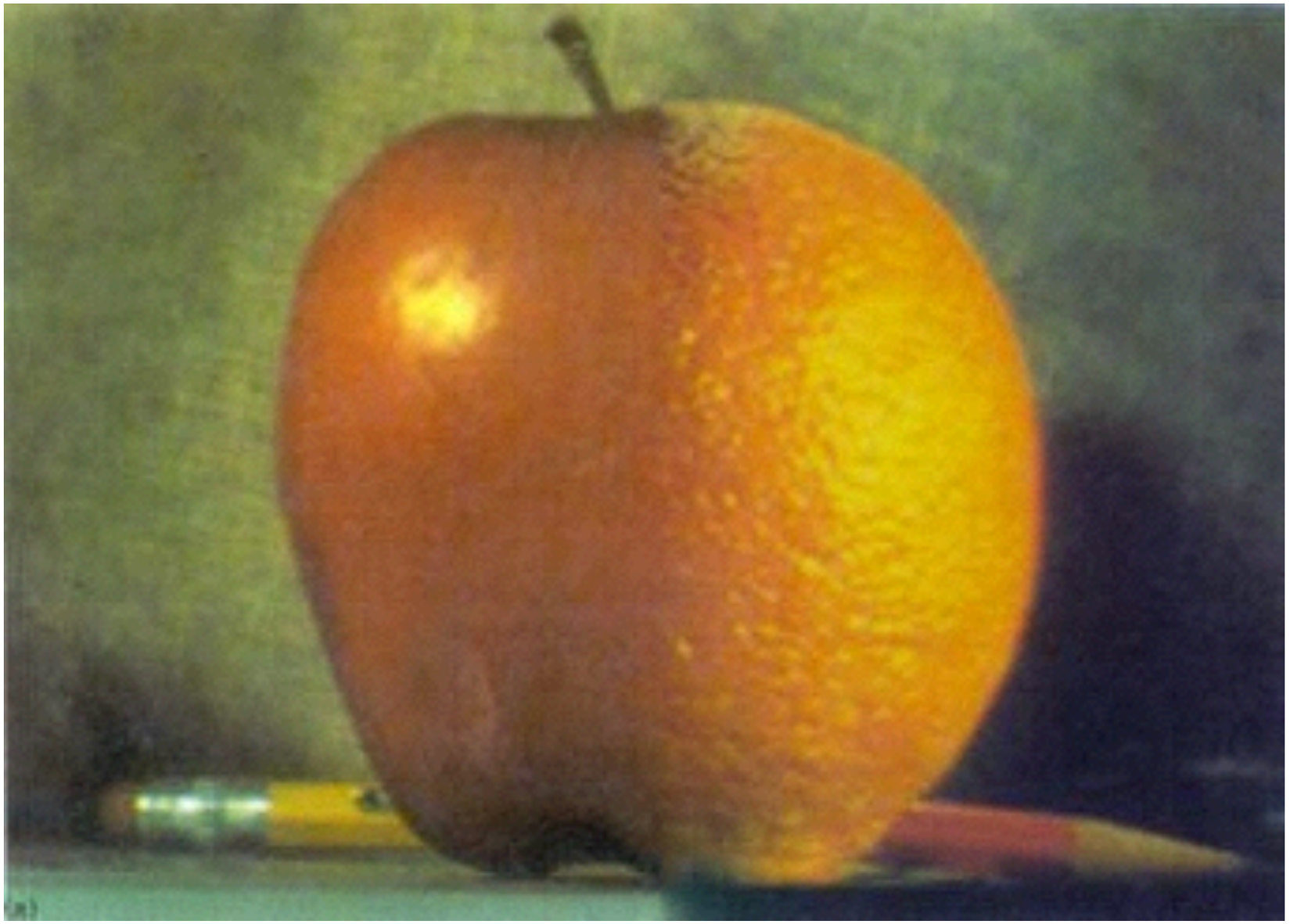


Image Blending

Computational Photography 15-463

Techniques for compositing

- Cut-and-paste
- Alpha blending
- Multi-band blending
- Poisson blending
- Seam stitching

Cut and Paste

Do you remember this from elementary school?

Is this bad?

http://derekgores.com/

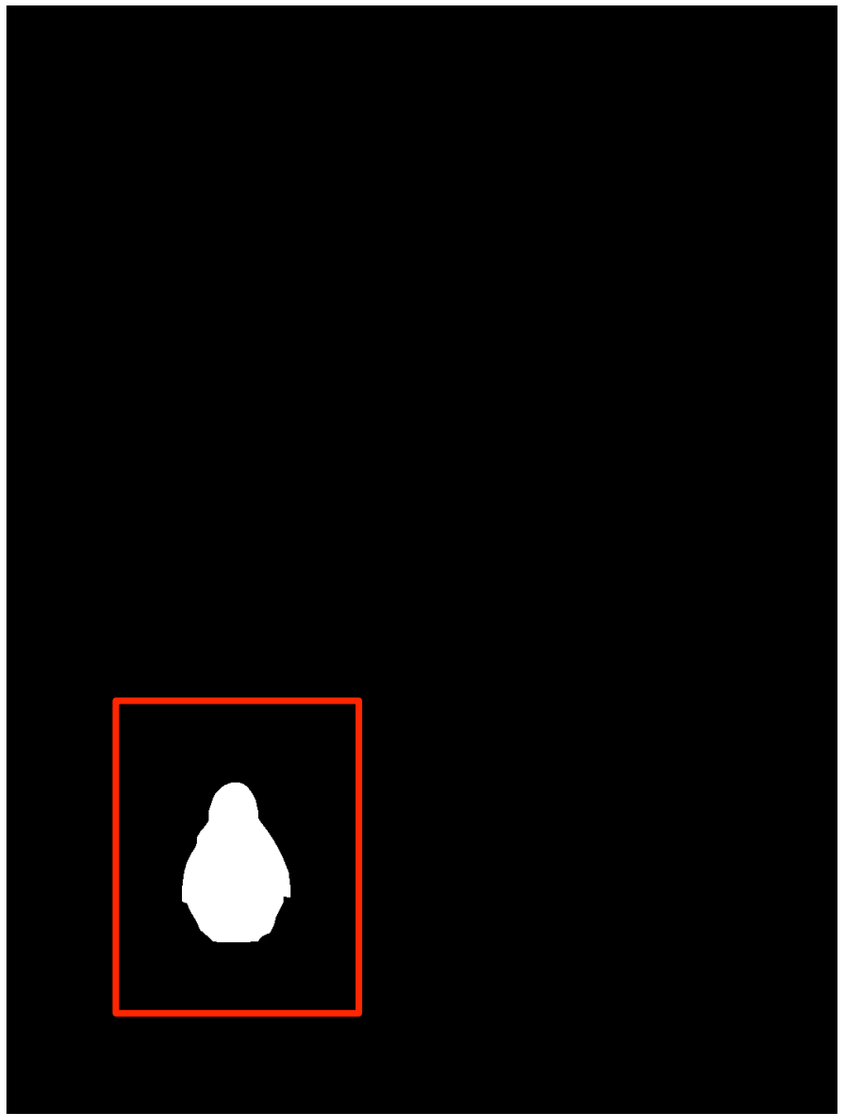
Alpha Blending

(A.K.A. Alpha composite, Alpha Matte)

foreground

background

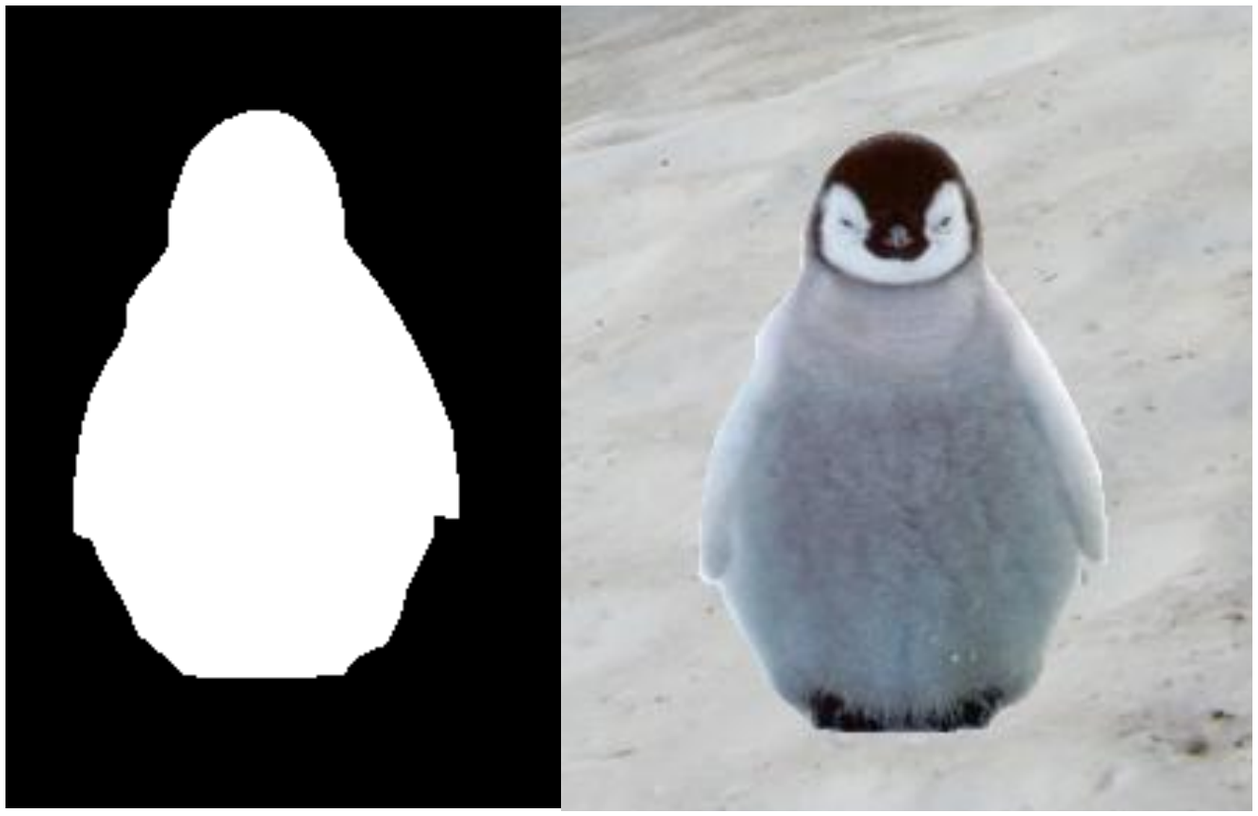
mask



output

Output = foreground * mask + background * (1-mask)

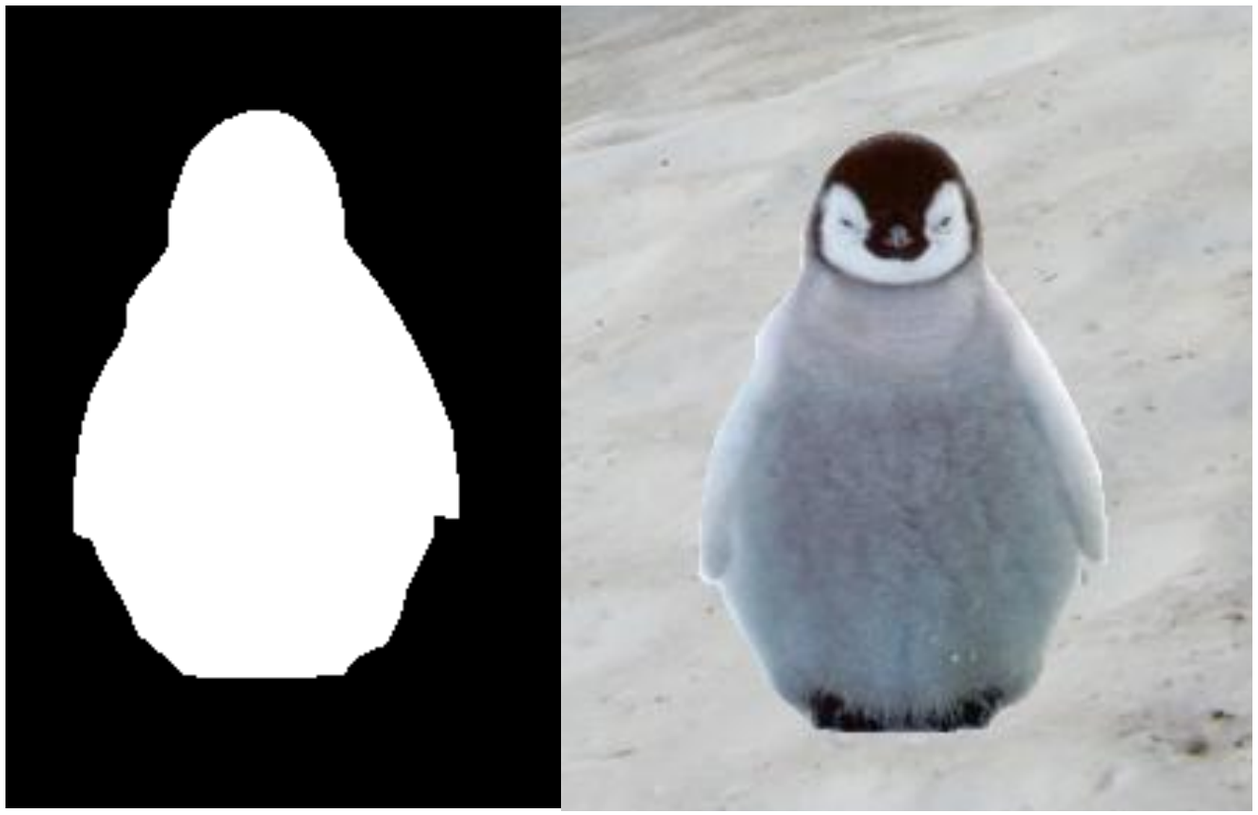
binary alpha mask



Why does this look unnatural?

How can we fix it?

binary alpha mask

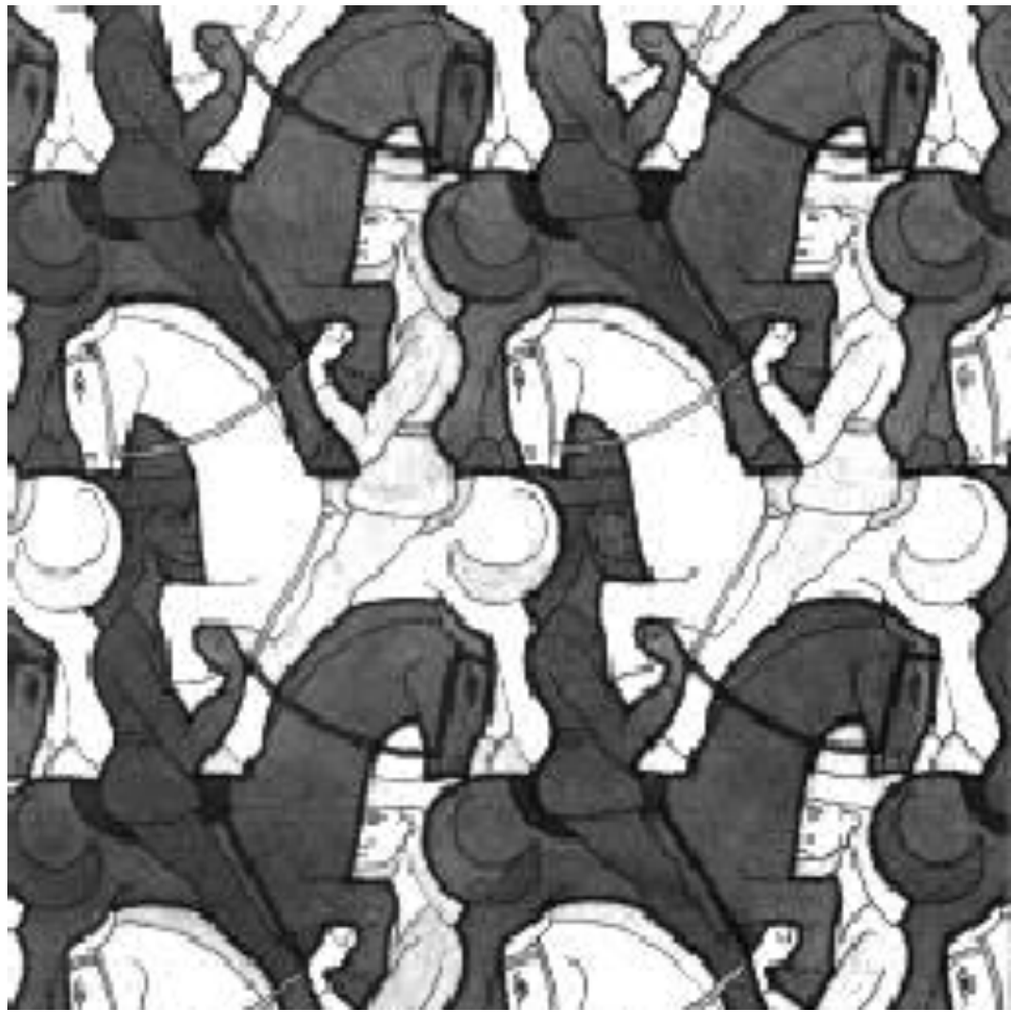


feathering (smoothed alpha)

How could you implement feathering?

Let's blend these two images...

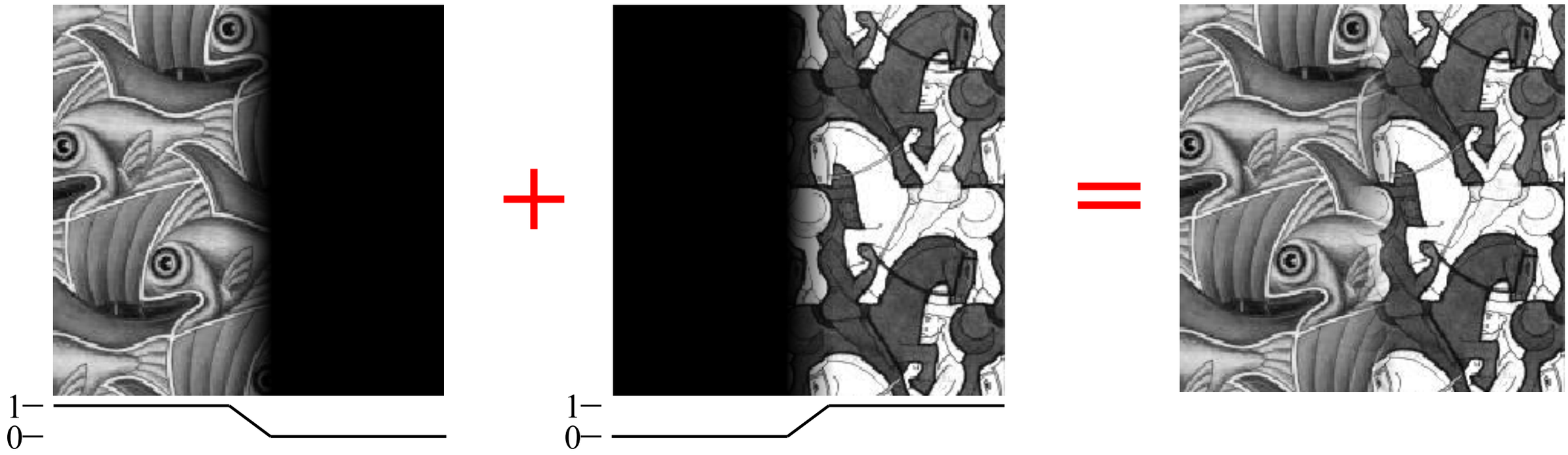
left side



right side

How would you do it?

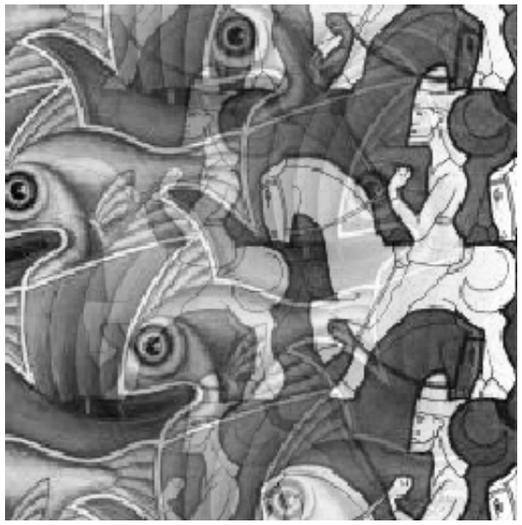
Feathering / Linear blending

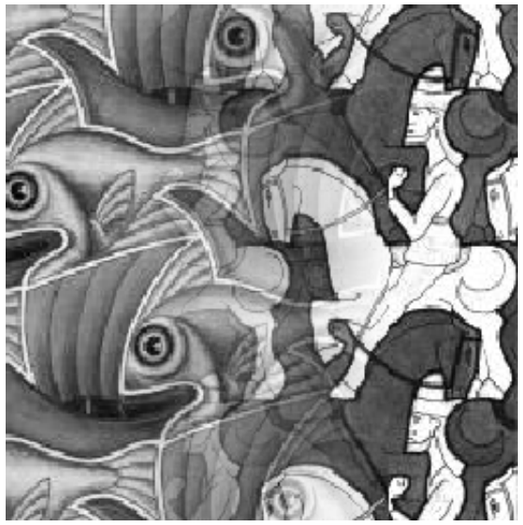


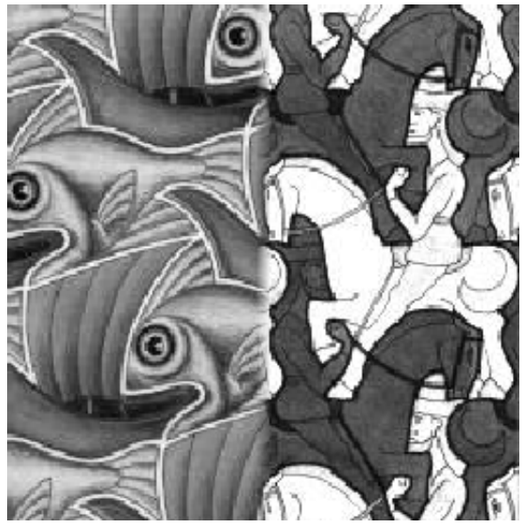
$$I_{blend} = \alpha I_{left} + (1-\alpha) I_{right}$$

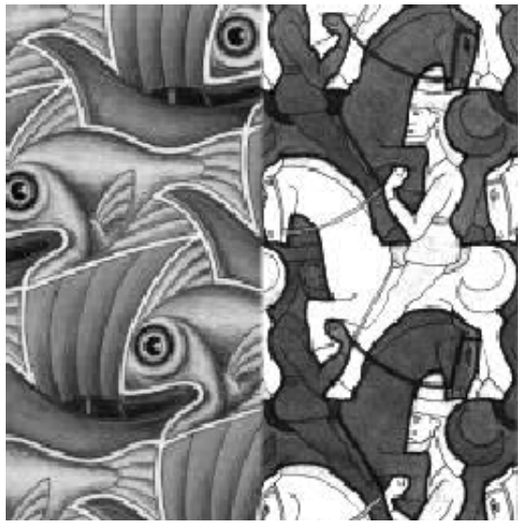
What is alpha?

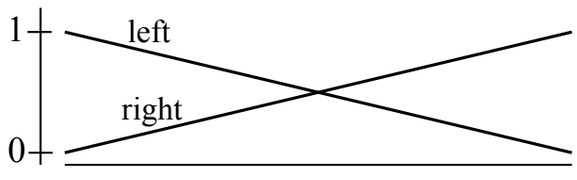
What kind of window is 'good'?

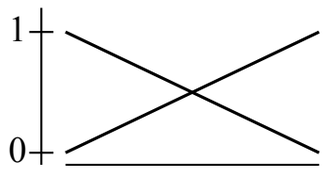


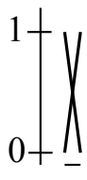


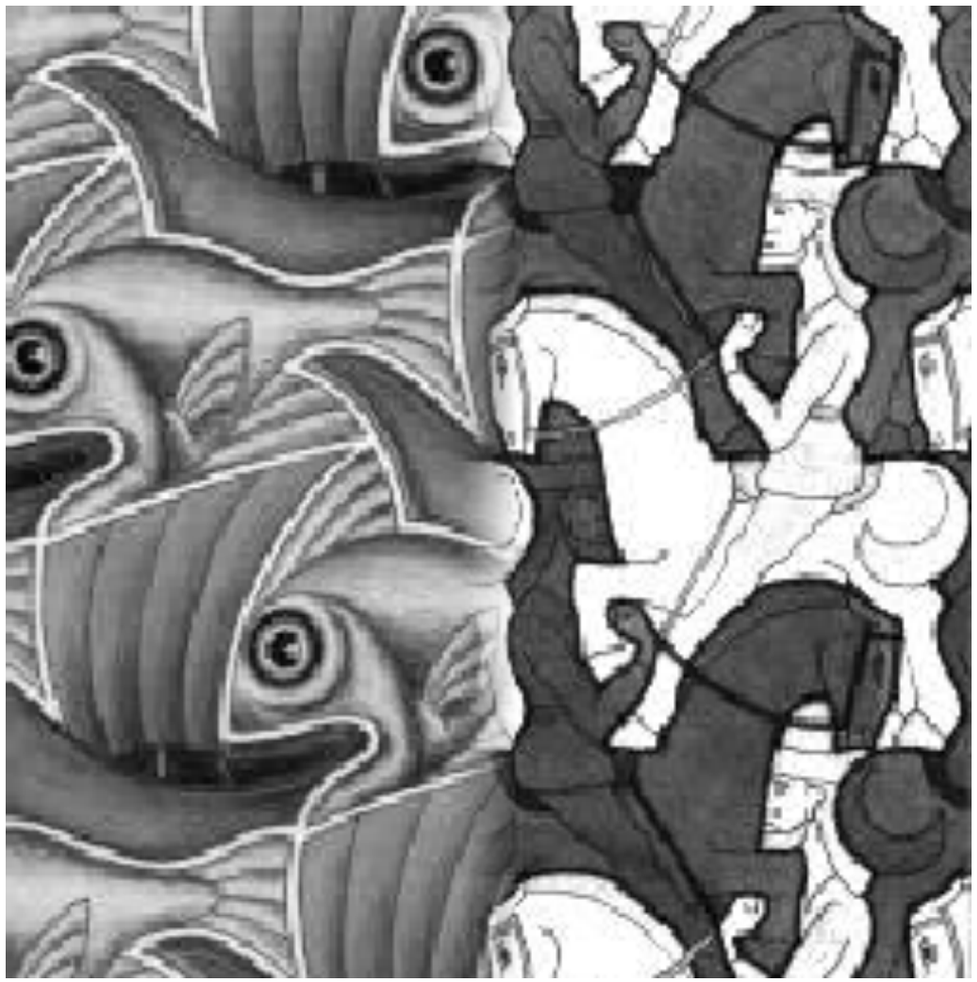


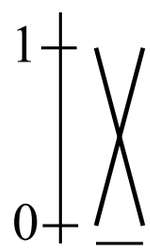








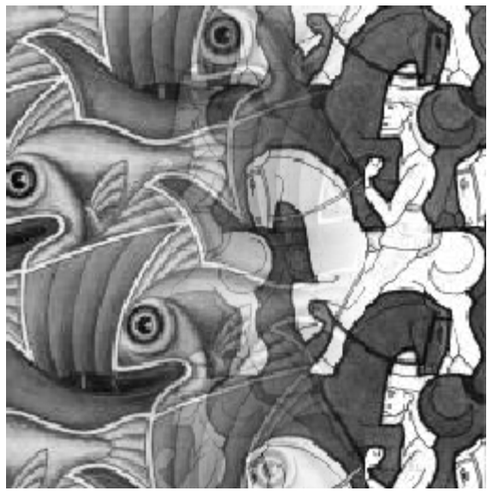




‘Good’ window: smooth but not ghosted

What is a good window size?

To avoid discontinuities:
window = size of largest prominent feature



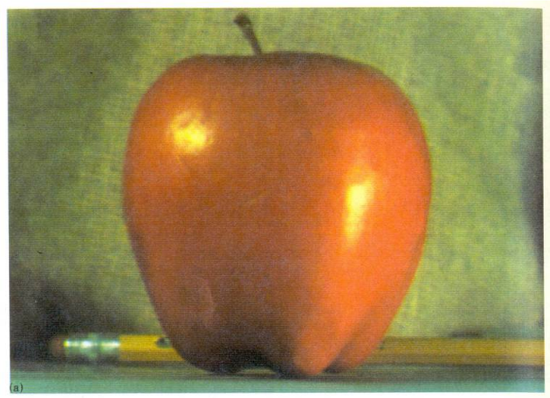
To avoid ghosting:
window <= 2*size of smallest prominent feature

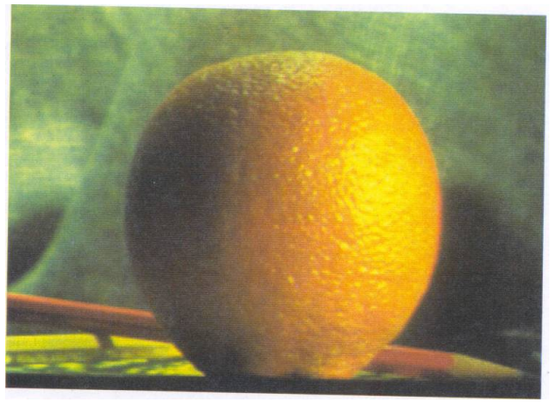
Fourier domain interpretation:

linear blending should work when:
image frequency content occupies roughly one "octave" (power of two)

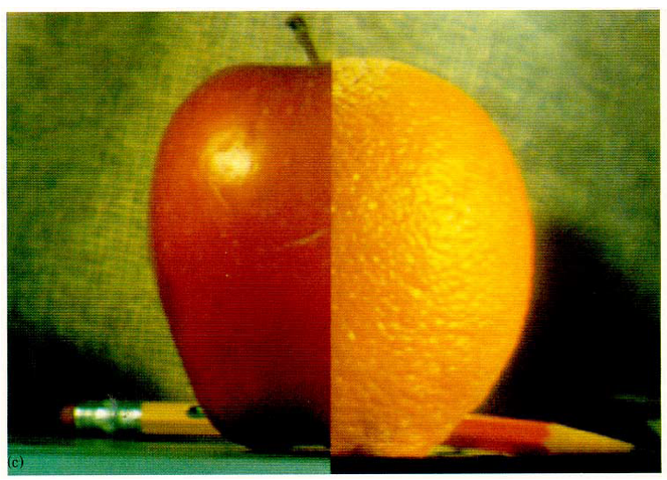
linear blending should work when:
largest frequency <= 2*size of smallest frequency

But what if the frequency is spread too wide?





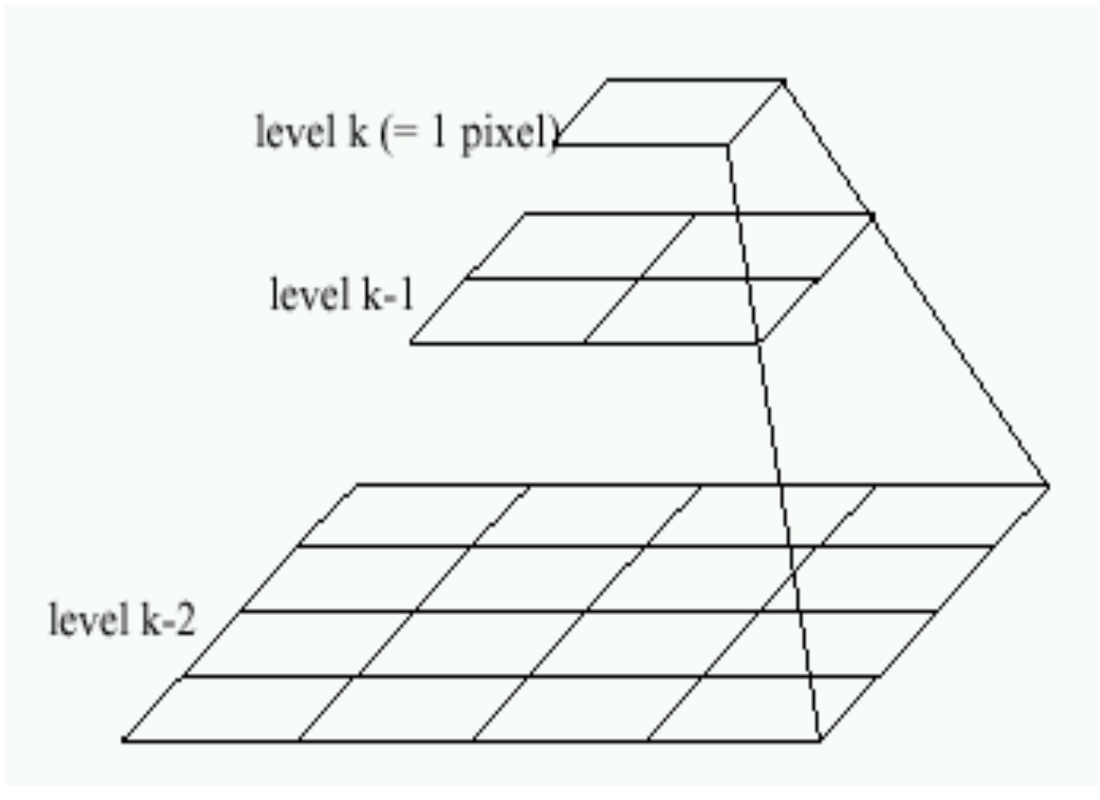
Multi-band Blending

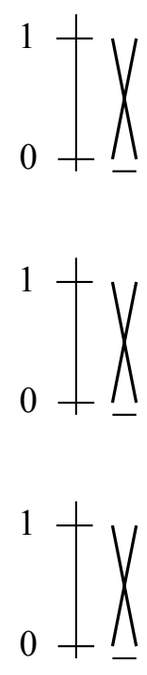


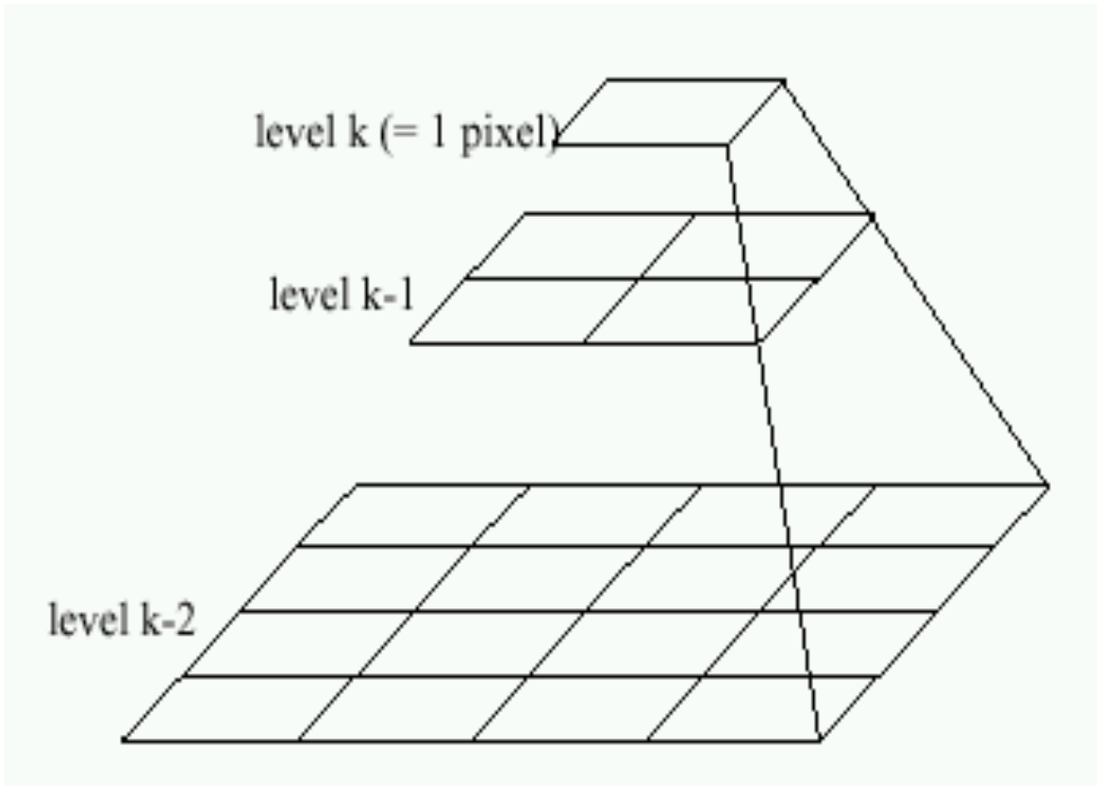
Burt & Adelson. A Multiresolution Spline With Application to Image Mosaics. TOG 1983

Multi-band / Pyramid Blending

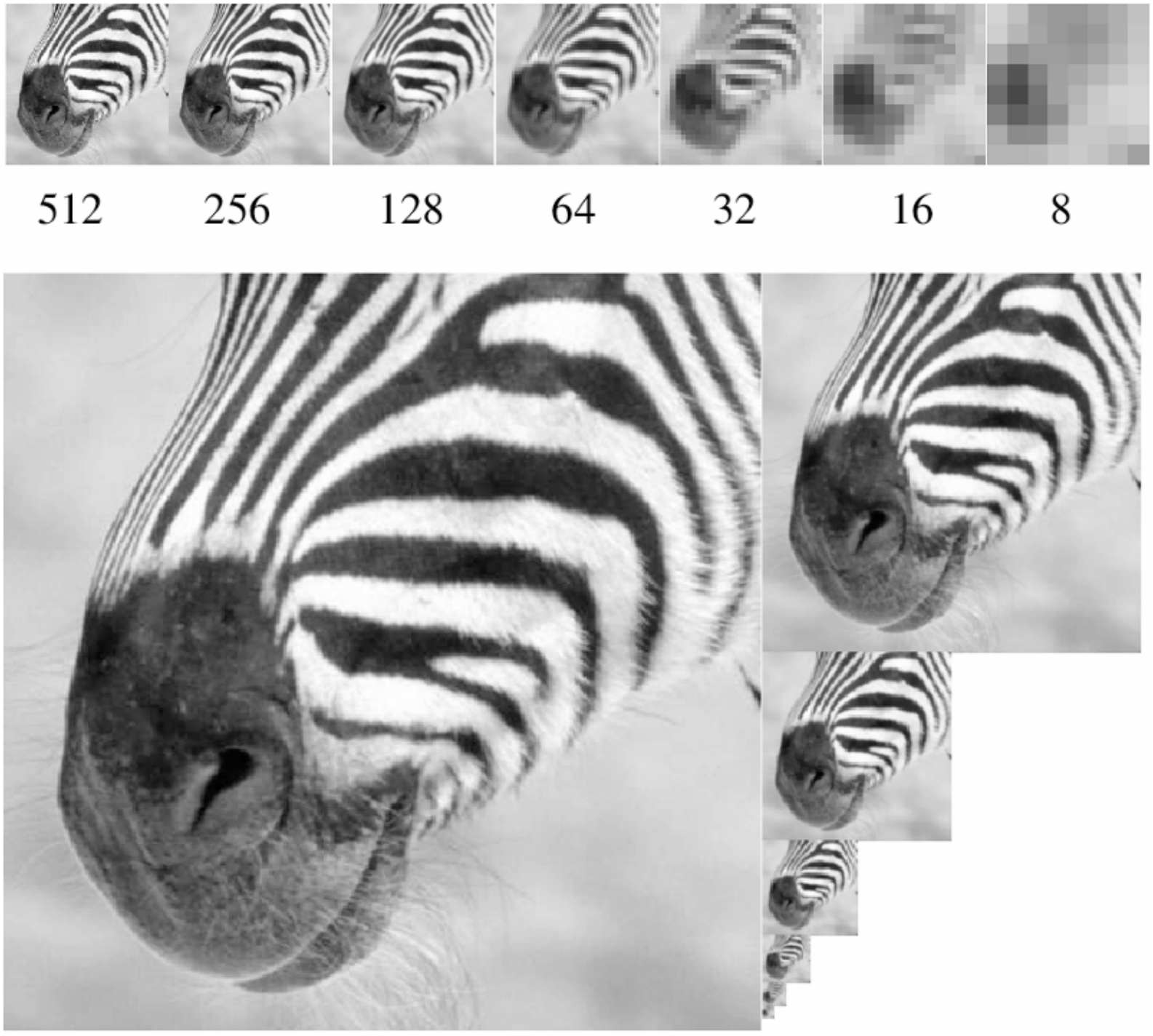
At low frequencies, blend slowly
At high frequencies, blend quickly







Left image Alpha mask Right image

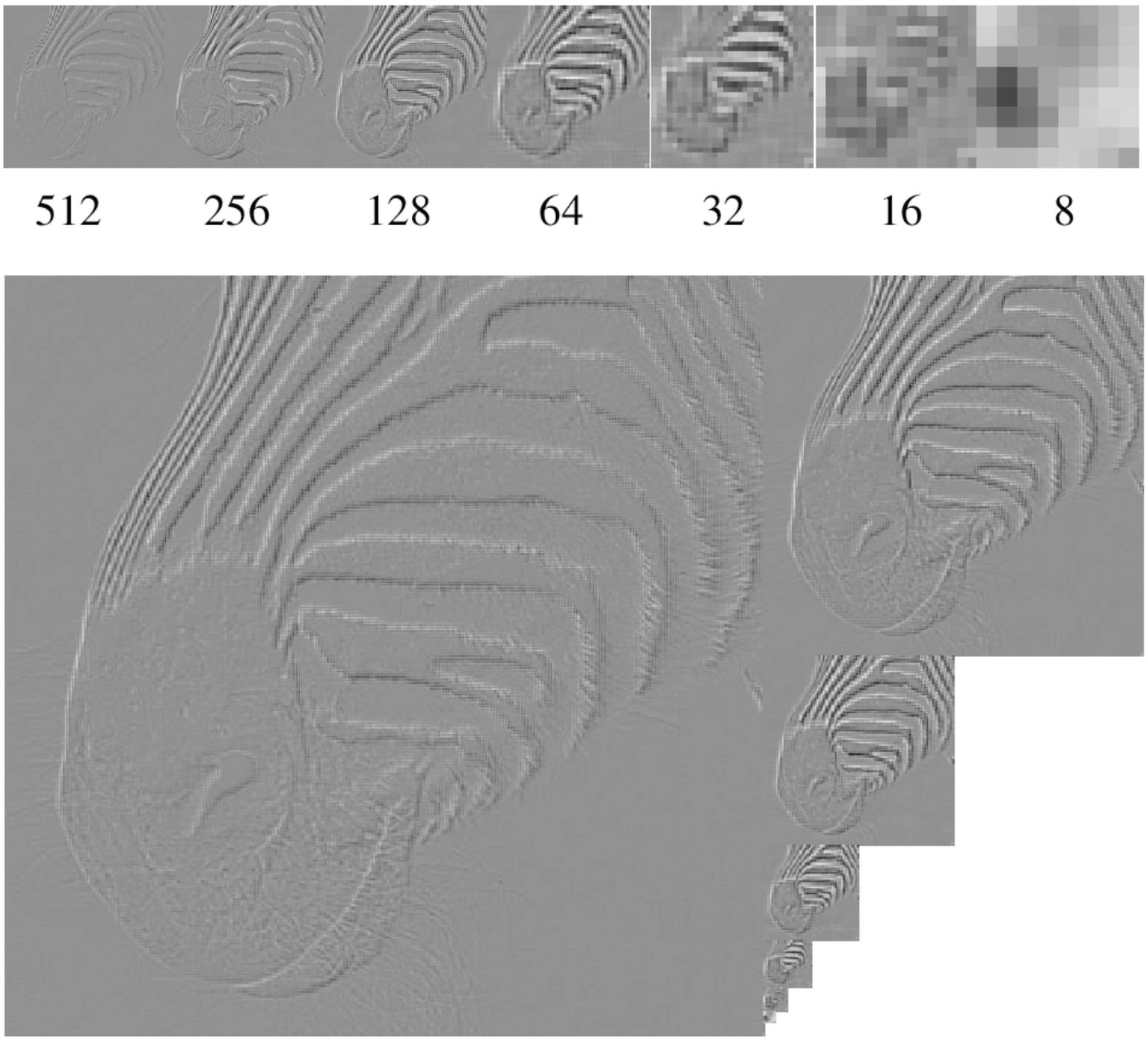


Gaussian pyramid

What happens to the details of the image?

What is preserved at the higher scales?

How would you reconstruct the original image using the upper pyramid?



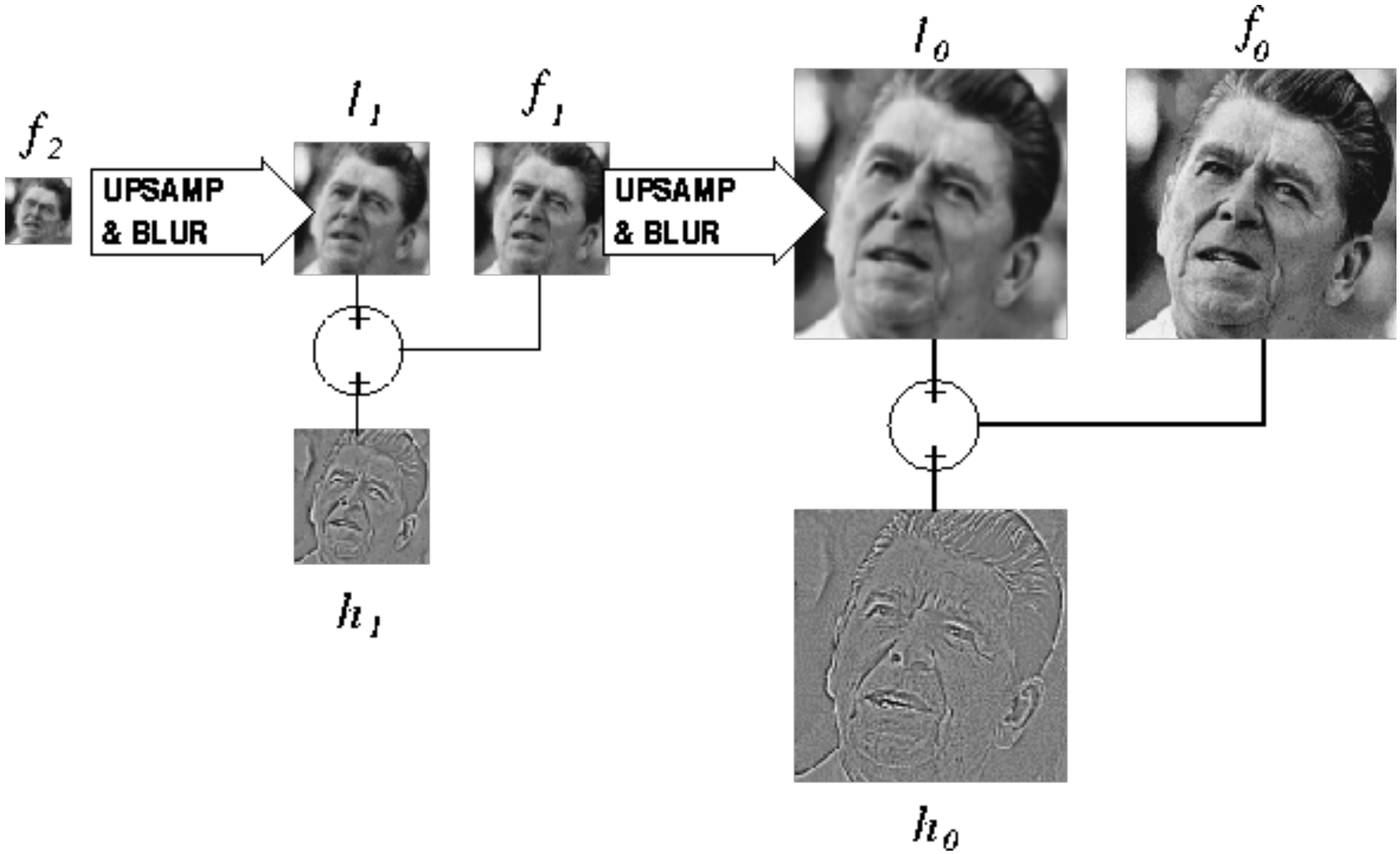
Laplacian pyramid

Retains the residuals (details) between pyramid levels

Can you reconstruct the original image using the upper pyramid?

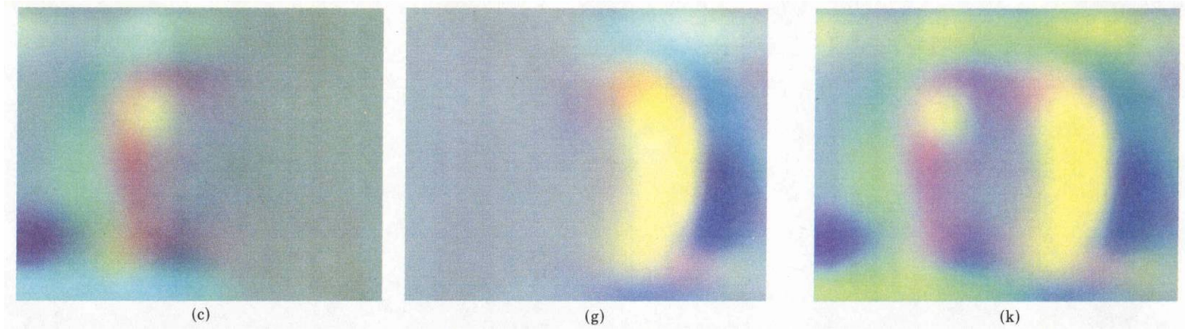
What exactly do you need to reconstruct the original image?

Quick review of Gaussian and Laplacian pyramid:

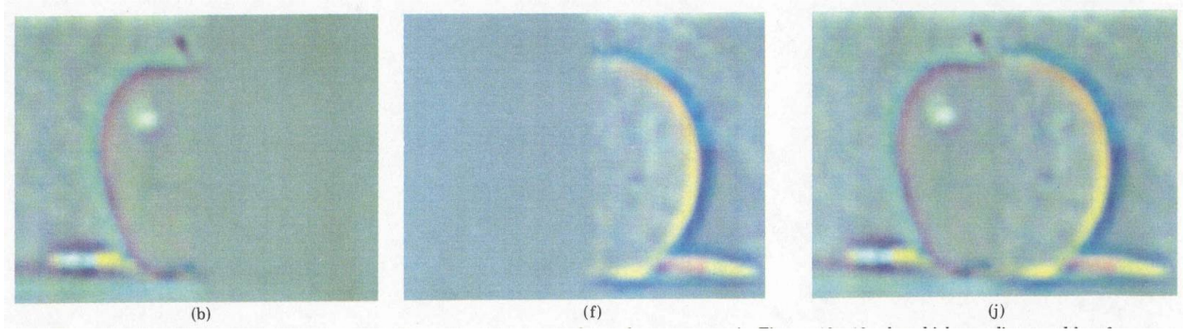


Multi-band / Pyramid Blending

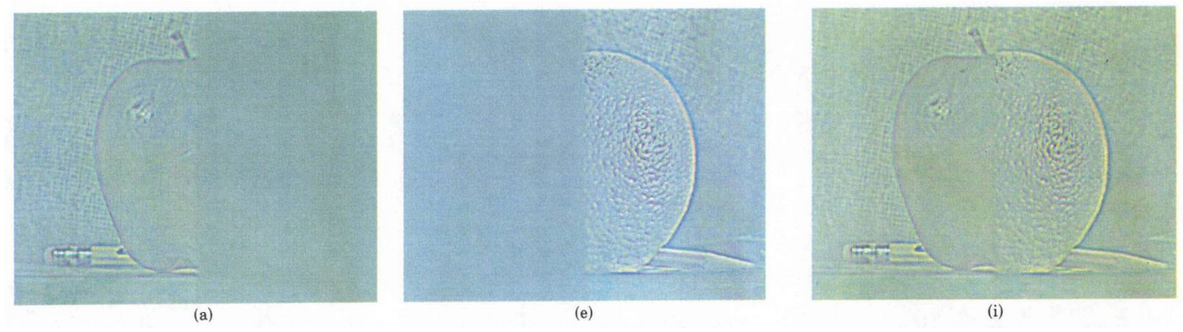
Laplacian Level 4



Laplacian Level 2



Laplacian Level 0



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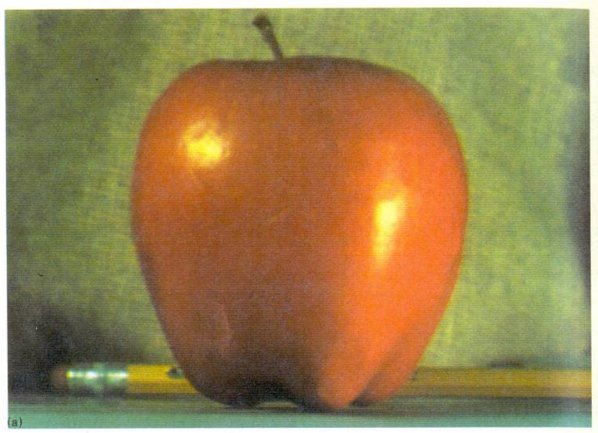
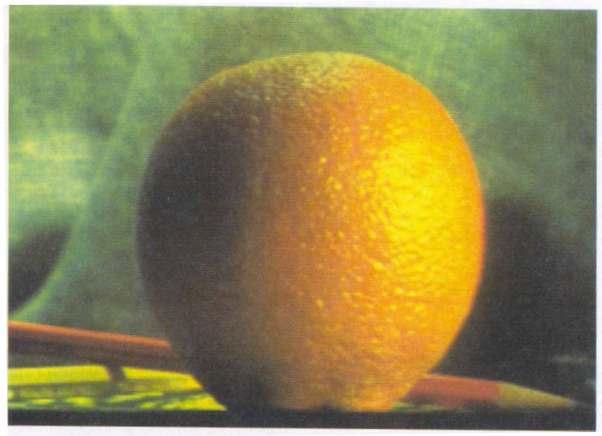
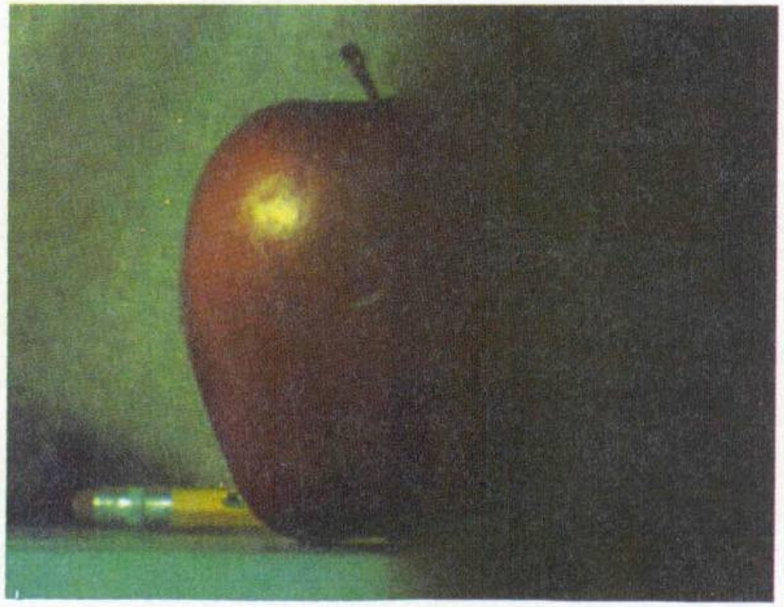
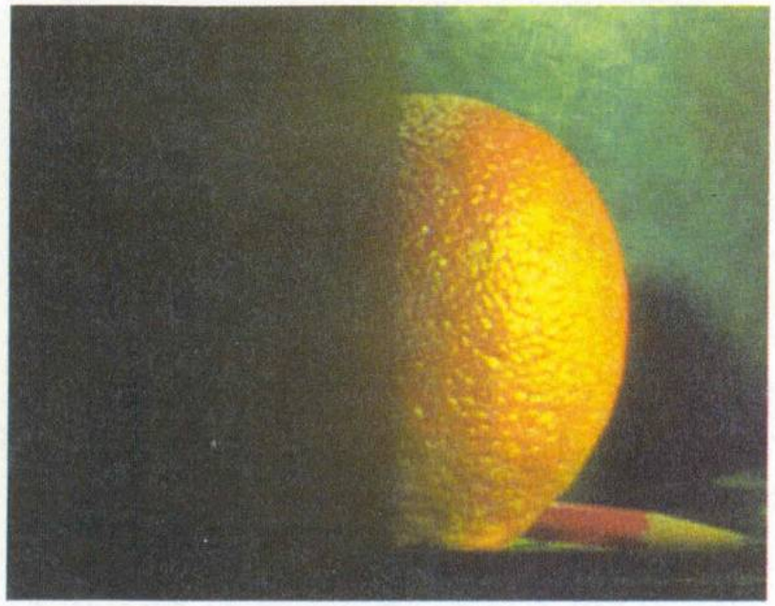


(a)

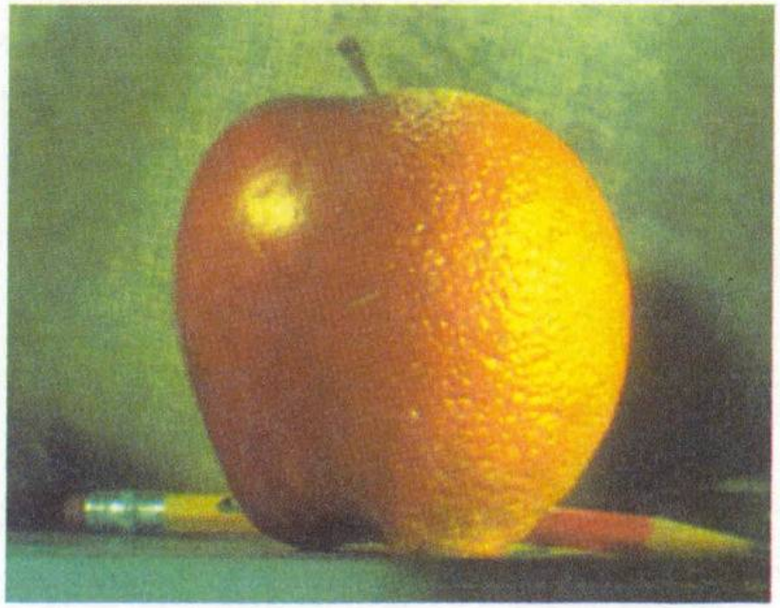




(d)



(h)



(l)

Burt & Adelson. A Multiresolution Spline With Application to Image Mosaics. TOG 1983

Implementation:

1. Build Laplacian pyramids for each image

how many pyramids?

2. Blend each level of pyramid using region mask

$$L_{12}^{i} = L_{1}^{i} \cdot R^{i} + L_{2}^{i} \cdot (1 - R^{i})$$

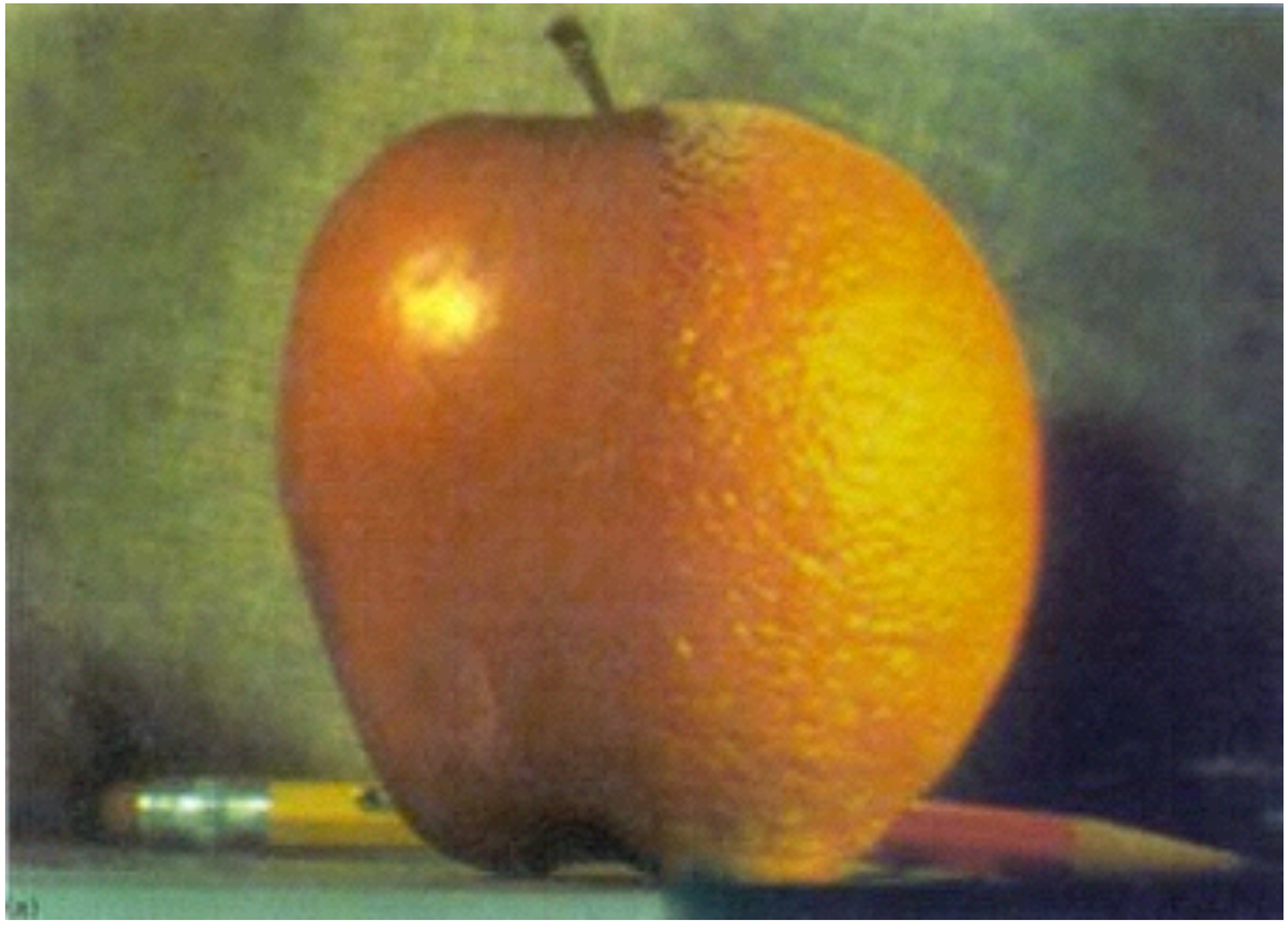
what are the dimensions?

Image 1 at level i of Laplacian pyramid

Region mask at level i of Gaussian pyramid

4. Collapse the pyramid to get the final blended image

how?



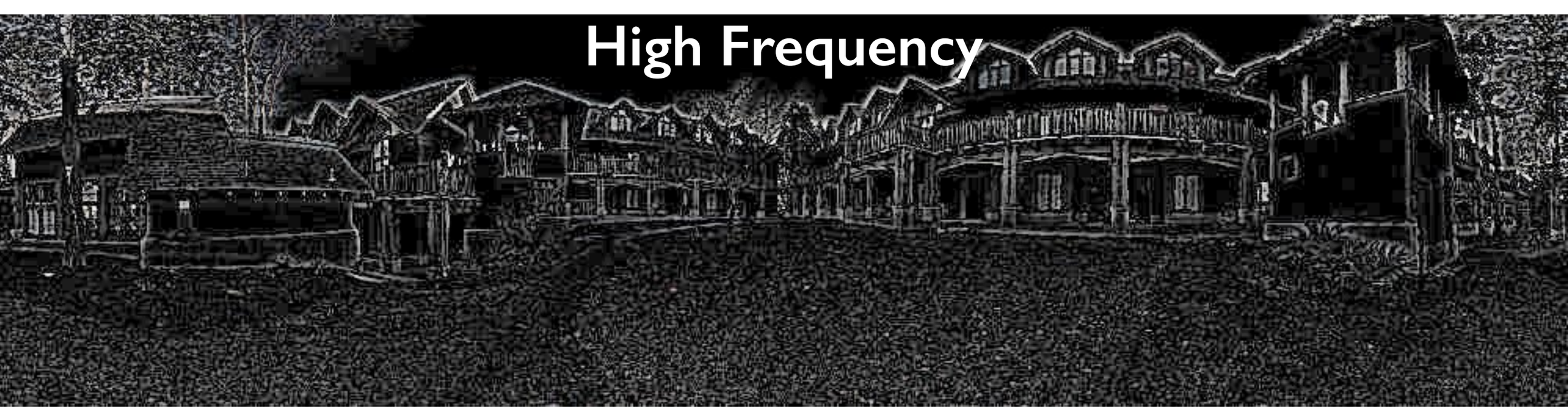
Can you get the same effect with less computation?

Two-band blending

Only use two bands:
high frequency and low frequency
Blends low frequency with smooth alpha
Blends high frequency with binary alpha

Brown, Lowe. Recognising panoramas. ICCV 2003


Low Frequency


High Frequency

Linear Blending

Two-band Blending