

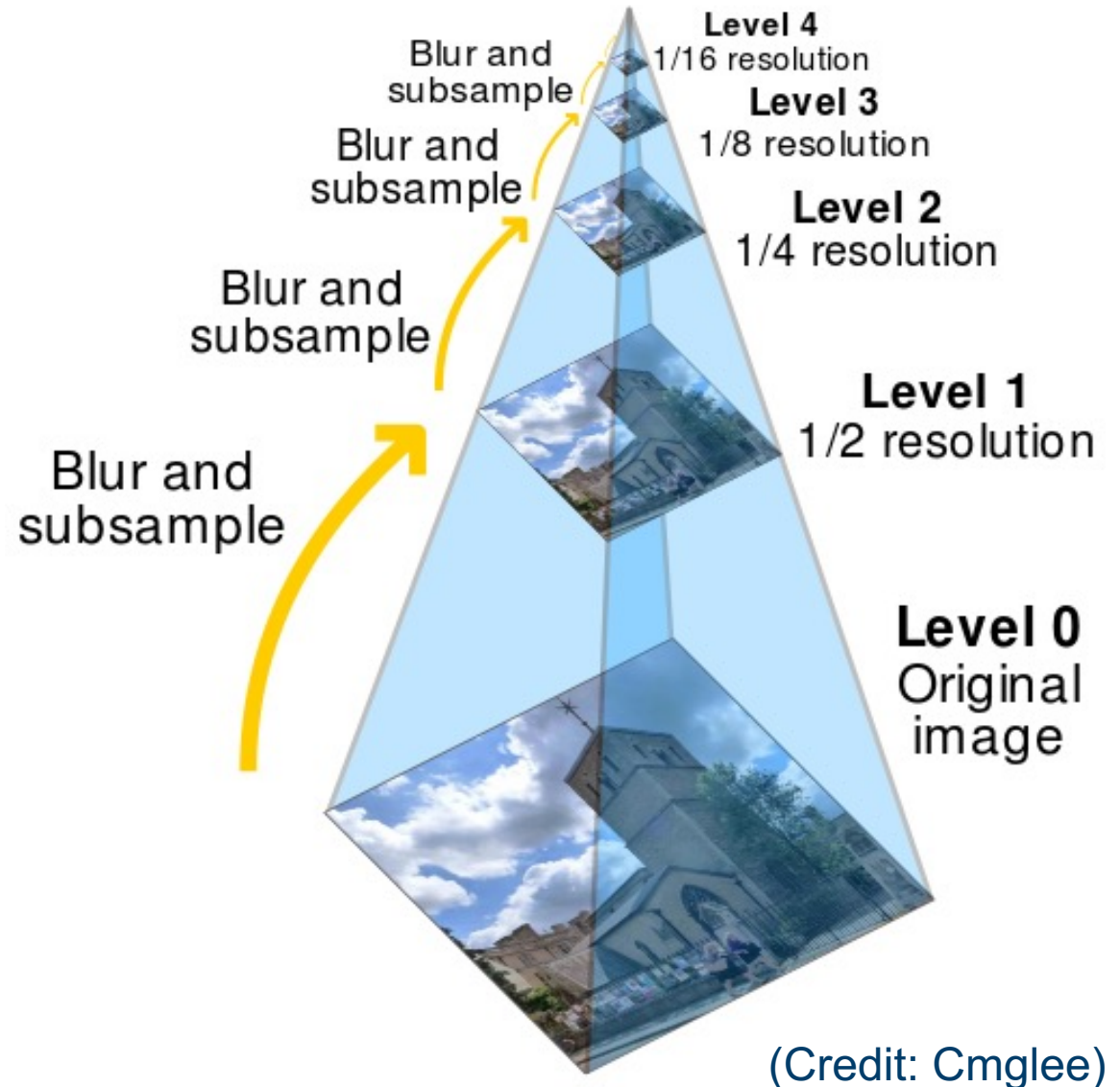
Laplace blending

Idar Dyrdal



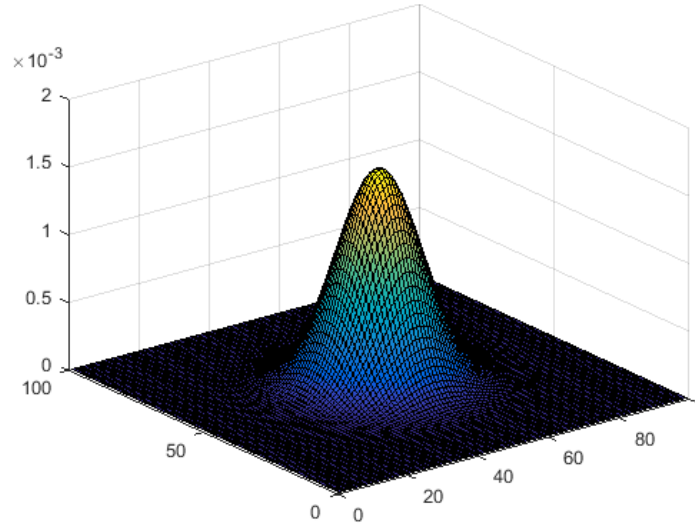
Image Pyramids

- Downsampling (decimation)
- Upsampling (interpolation)
- Pyramids
 - Gaussian Pyramids
 - **Laplacian Pyramids**
- Applications
 - Template matching (object detection)
 - Detecting stable points of interest
 - Image Registration
 - Compression
 - **Image Blending**
 - ...



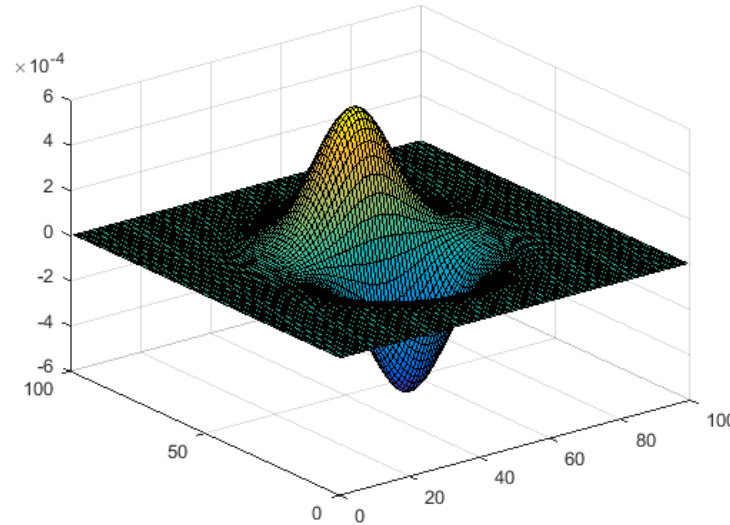
Gaussian and Laplacian operators

Gaussian (low-pass)



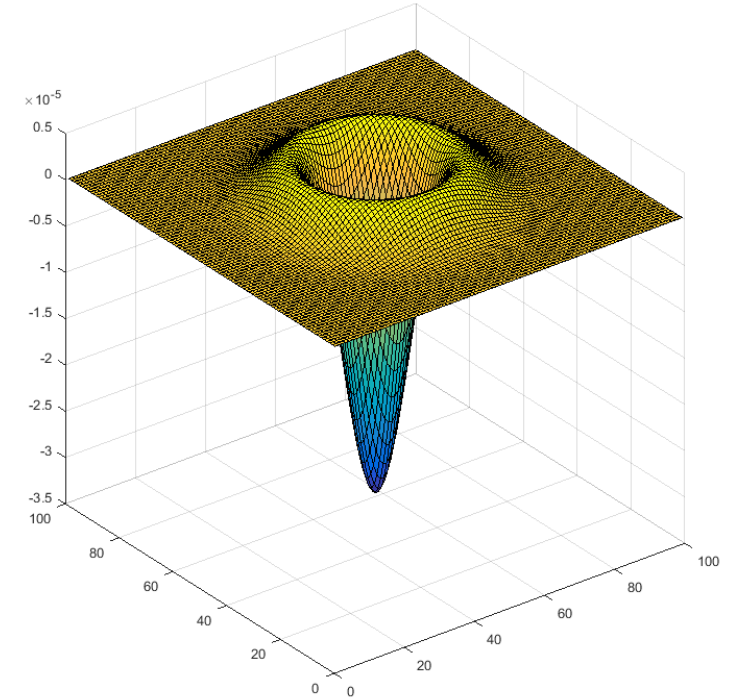
$$h_{\sigma}(u, v) = \frac{1}{2\pi\sigma^2} e^{-\left(\frac{u^2+v^2}{2\sigma^2}\right)}$$

Derivative of Gaussian



$$\frac{\partial}{\partial v} h_{\sigma}(u, v)$$

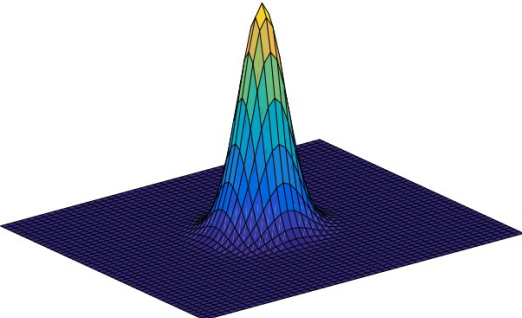
Laplacian of Gaussian (band-pass)



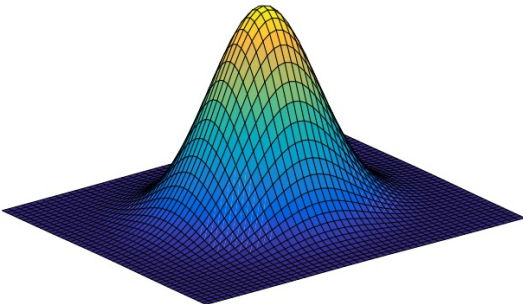
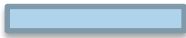
$$\nabla^2 h_{\sigma}(u, v)$$

Laplacian operator: $\nabla^2 f = \frac{\partial^2 f}{\partial^2 x} + \frac{\partial^2 f}{\partial^2 y}$ (high-pass)

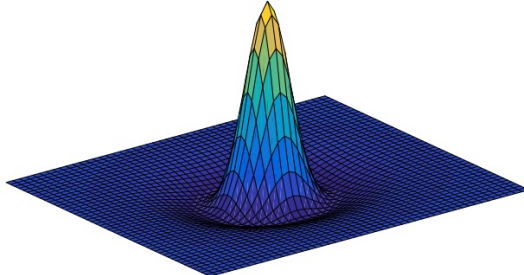
Difference of Gaussians (DoG) - approximation to Laplacian of Gaussian (LoG)



Small variance



Large variance



DoG

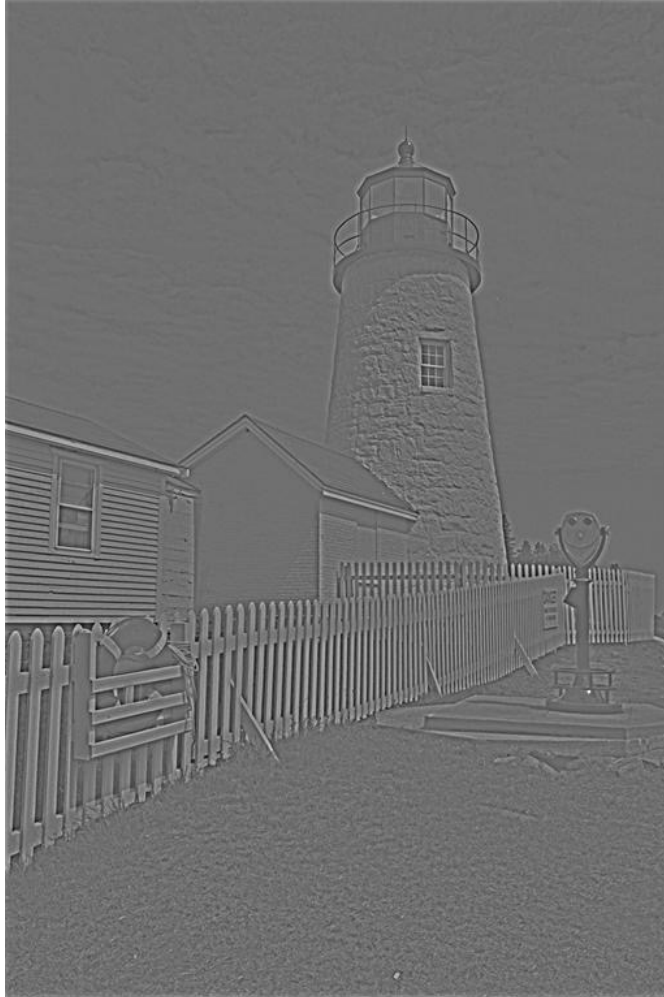
Difference of Gaussians - example



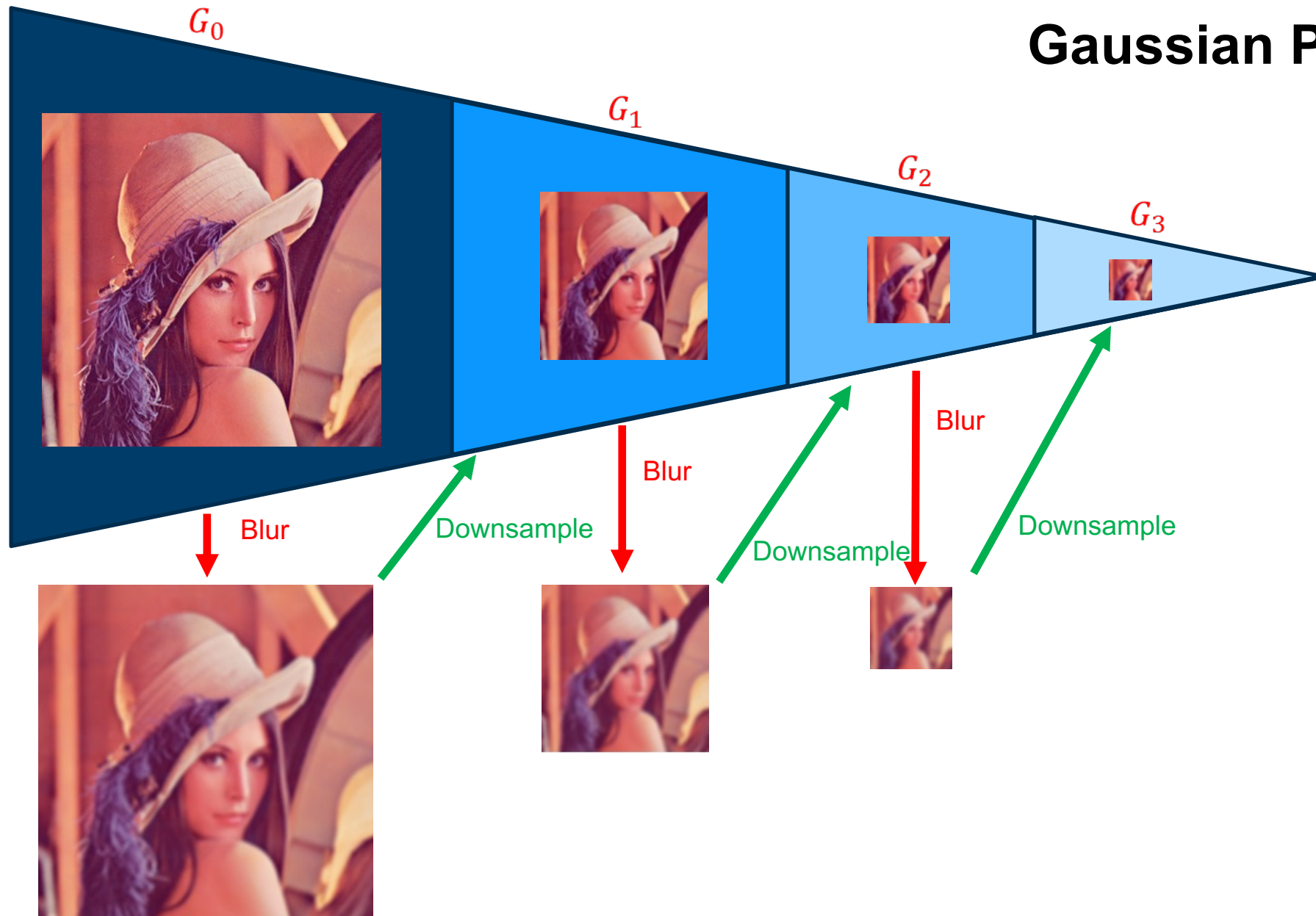
-



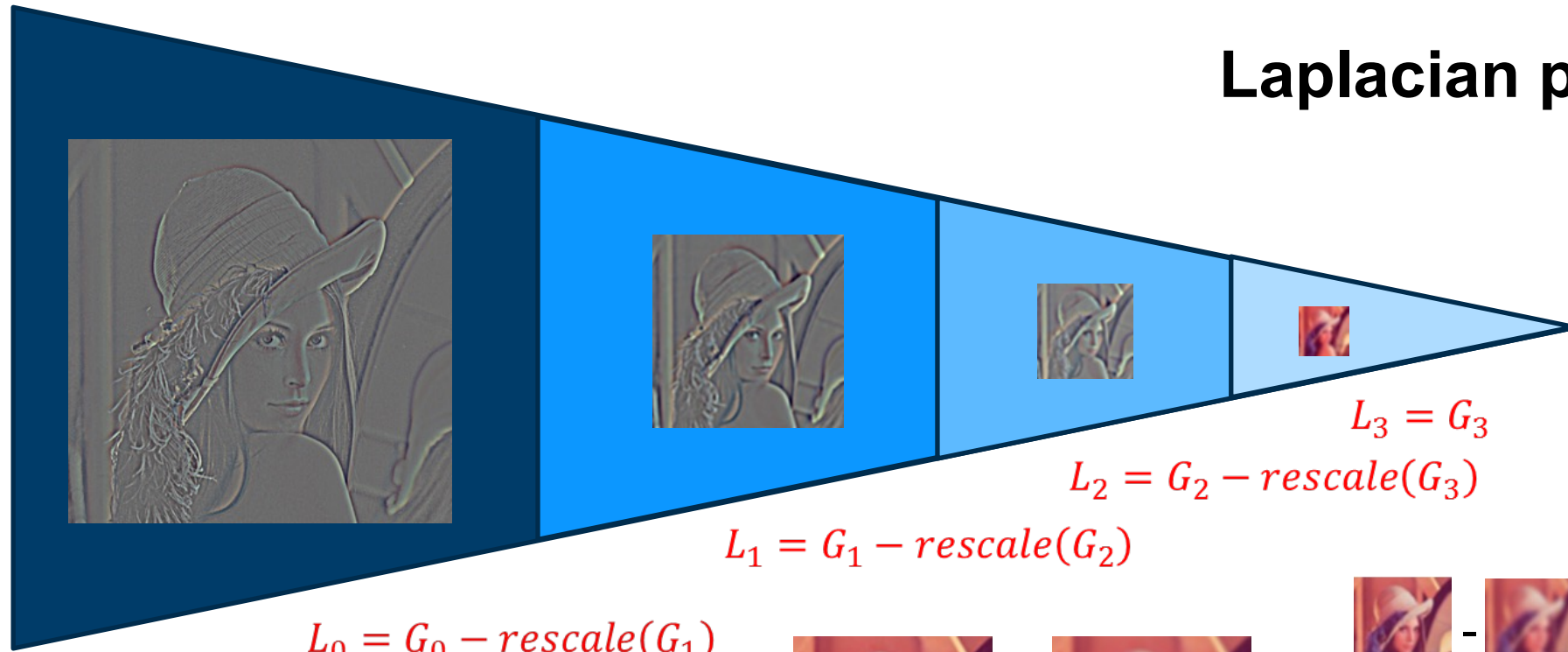
=



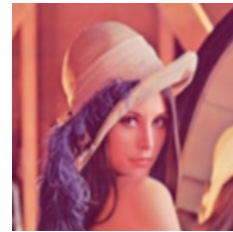
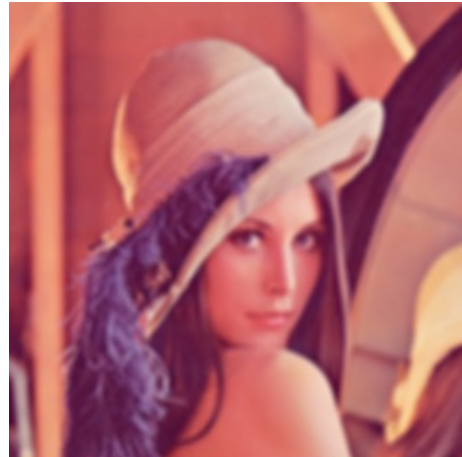
Gaussian Pyramid



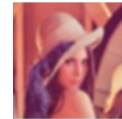
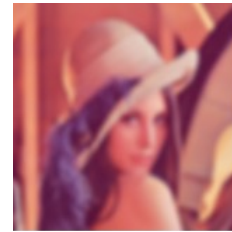
Laplacian pyramid



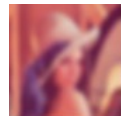
-



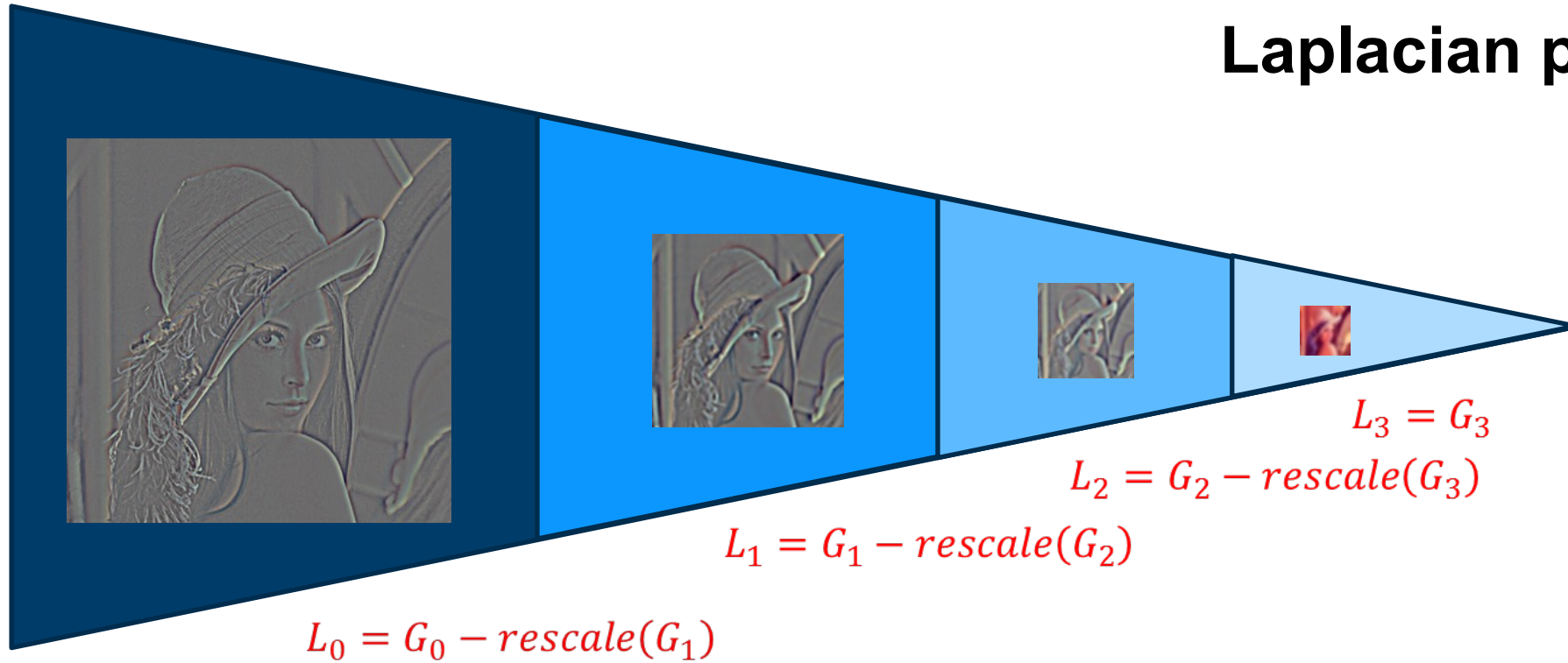
-



-



Laplacian pyramid



Collapsing the Laplacian pyramid:

$$\text{rescale}(\text{rescale}(\text{rescale}(L_3) + L_2) + L_1) + L_0 =$$

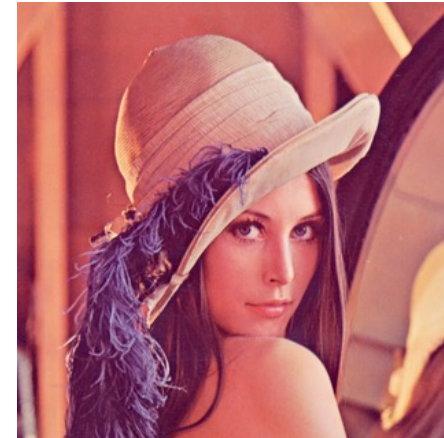
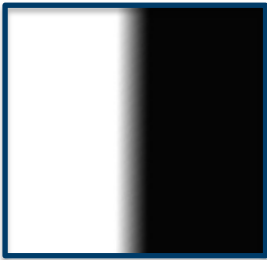


Image blending



Blending based on Laplacian pyramids

Steps:

- Choose img1 and img2 and crop/resize to the same size
- Chose a region mask of the same size
- Create Laplacian pyramid for img1 and img2
 - ◆ Create Gaussian pyramid for img1 and img2
 - ◆ Create Laplacian pyramids from Gaussian pyramids
- Create Gaussian pyramid for the region mask
- Blend the two Laplacian pyramids using the mask's Gaussian pyramid to weight the two images at each level of the pyramid
- Collapse the resulting Laplacian pyramid to reveal the blended image.



Image blending with Laplacian pyramids

Weighted sum for each level of the pyramid

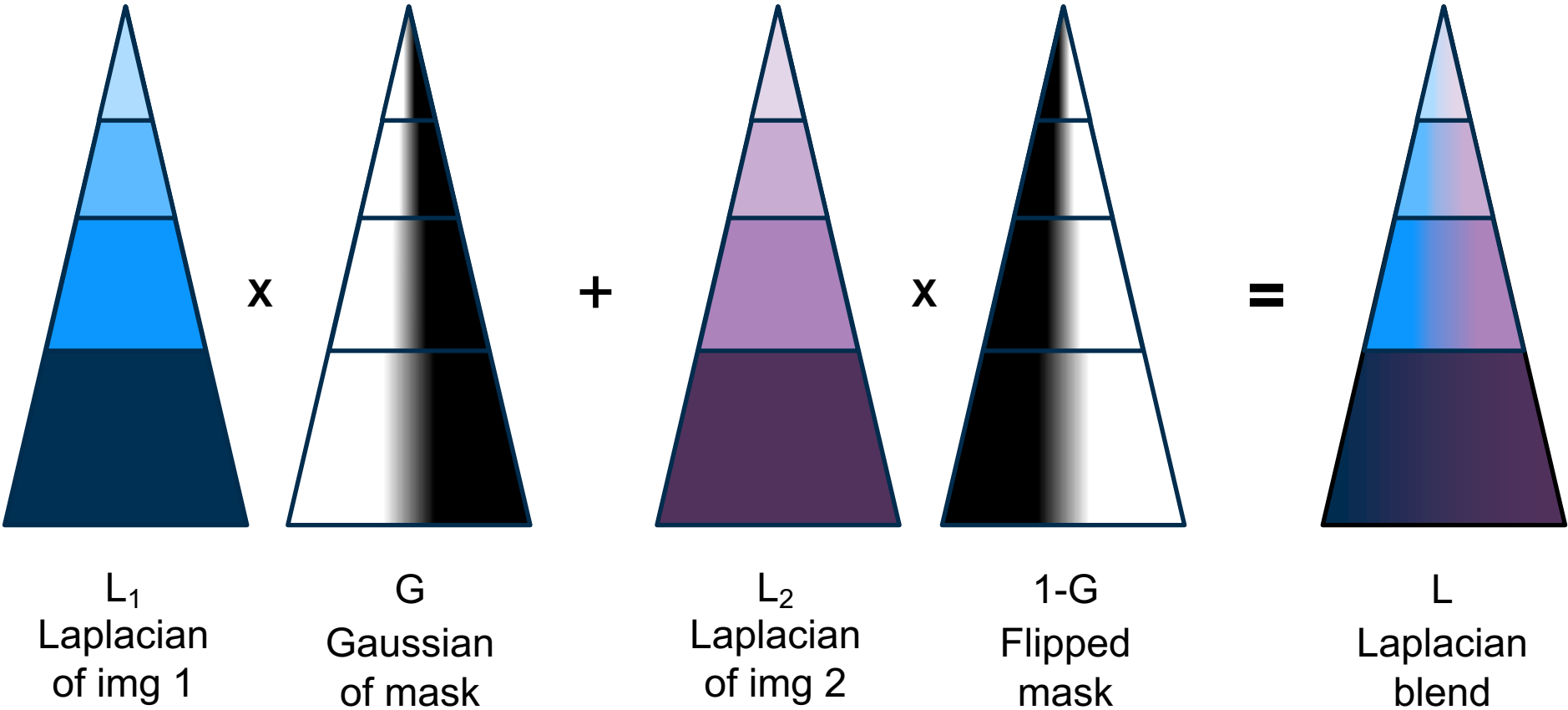
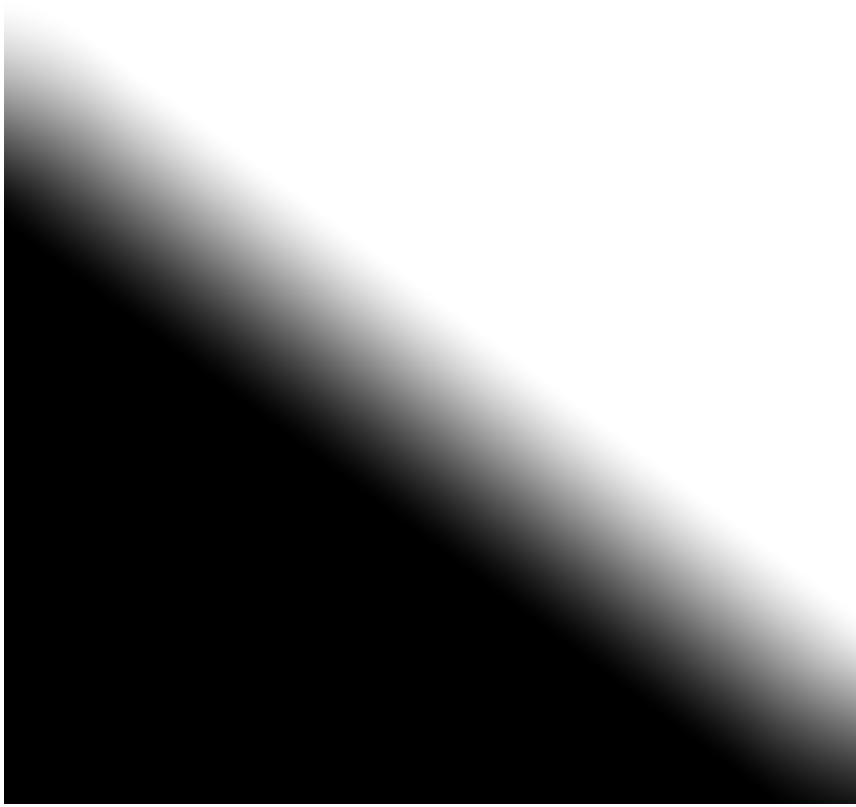


Image blending - example



Image 1



Mask

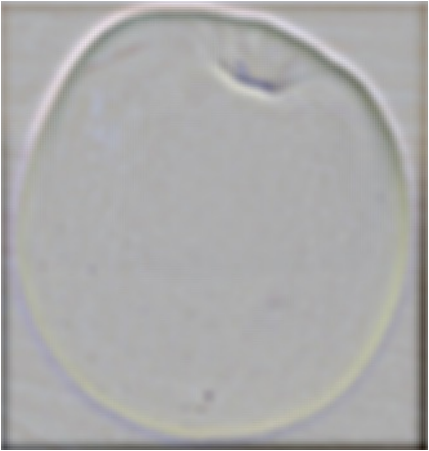


Image 2

Gaussian Pyramid - Image 1



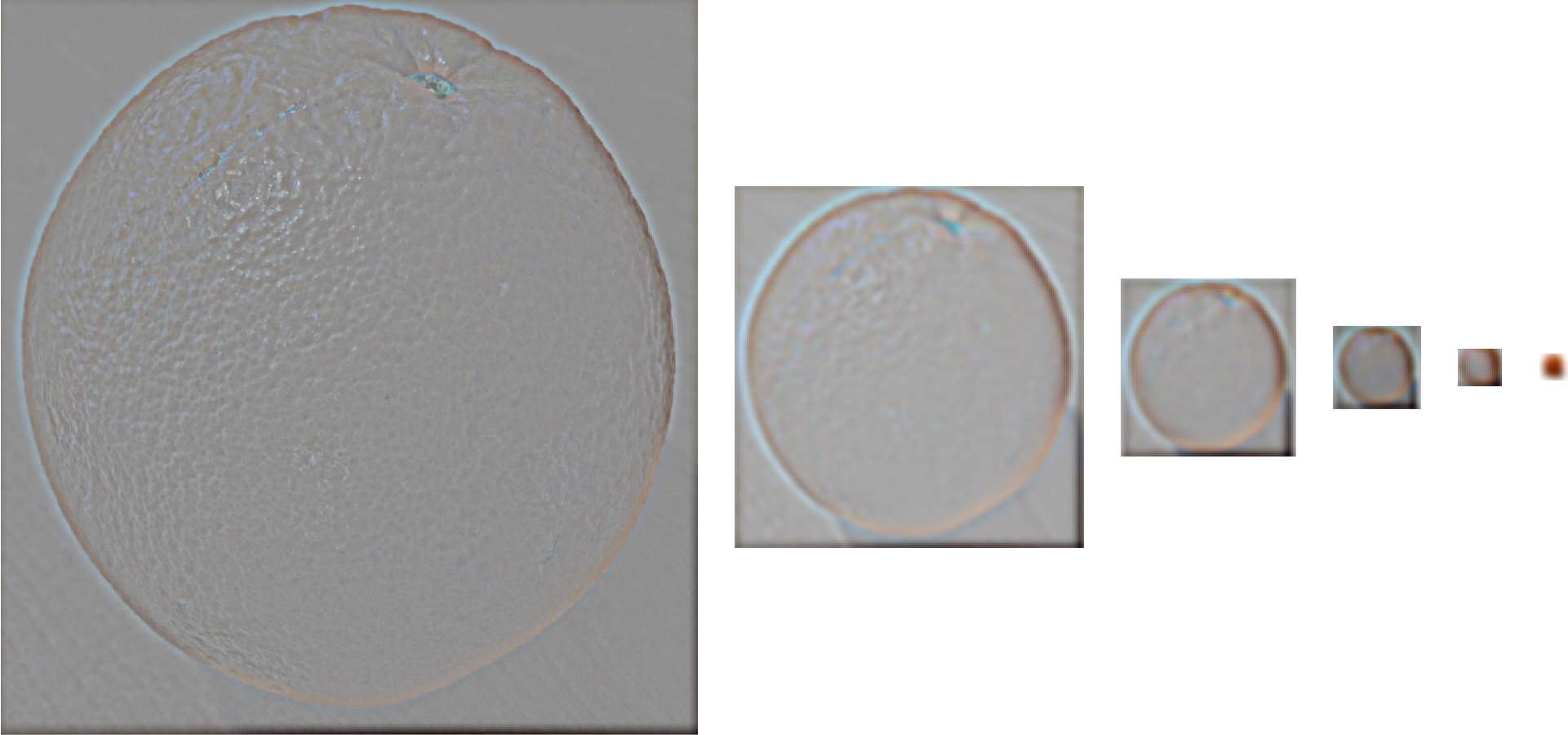
Laplacian Pyramid - Image 1



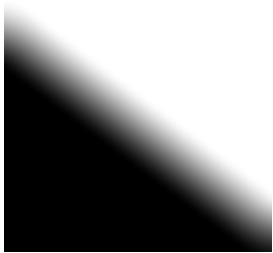
Gaussian Pyramid - Image 2



Laplacian Pyramid - Image 2



Gaussian Pyramid of the masks



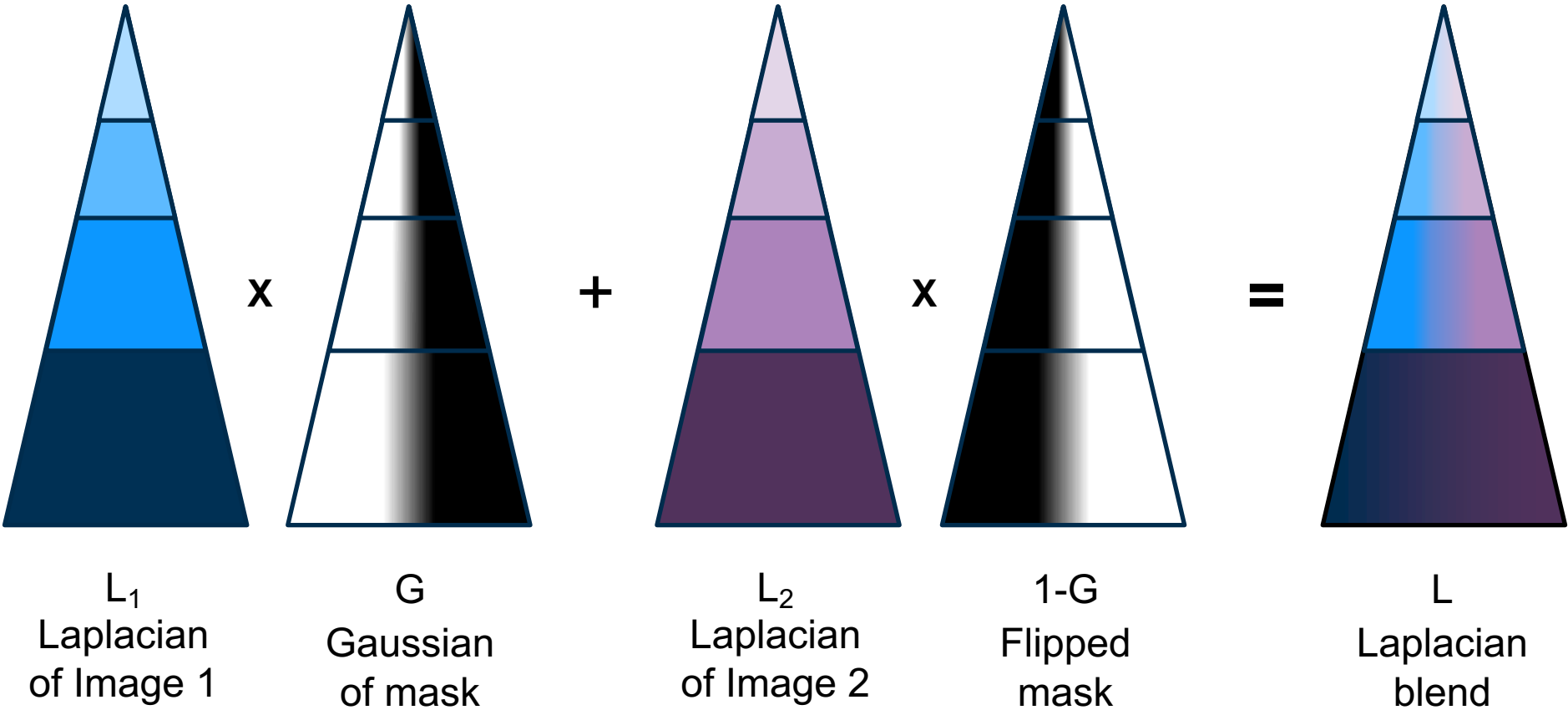
Mask (G)



Flipped mask (1-G)

Laplacian blending

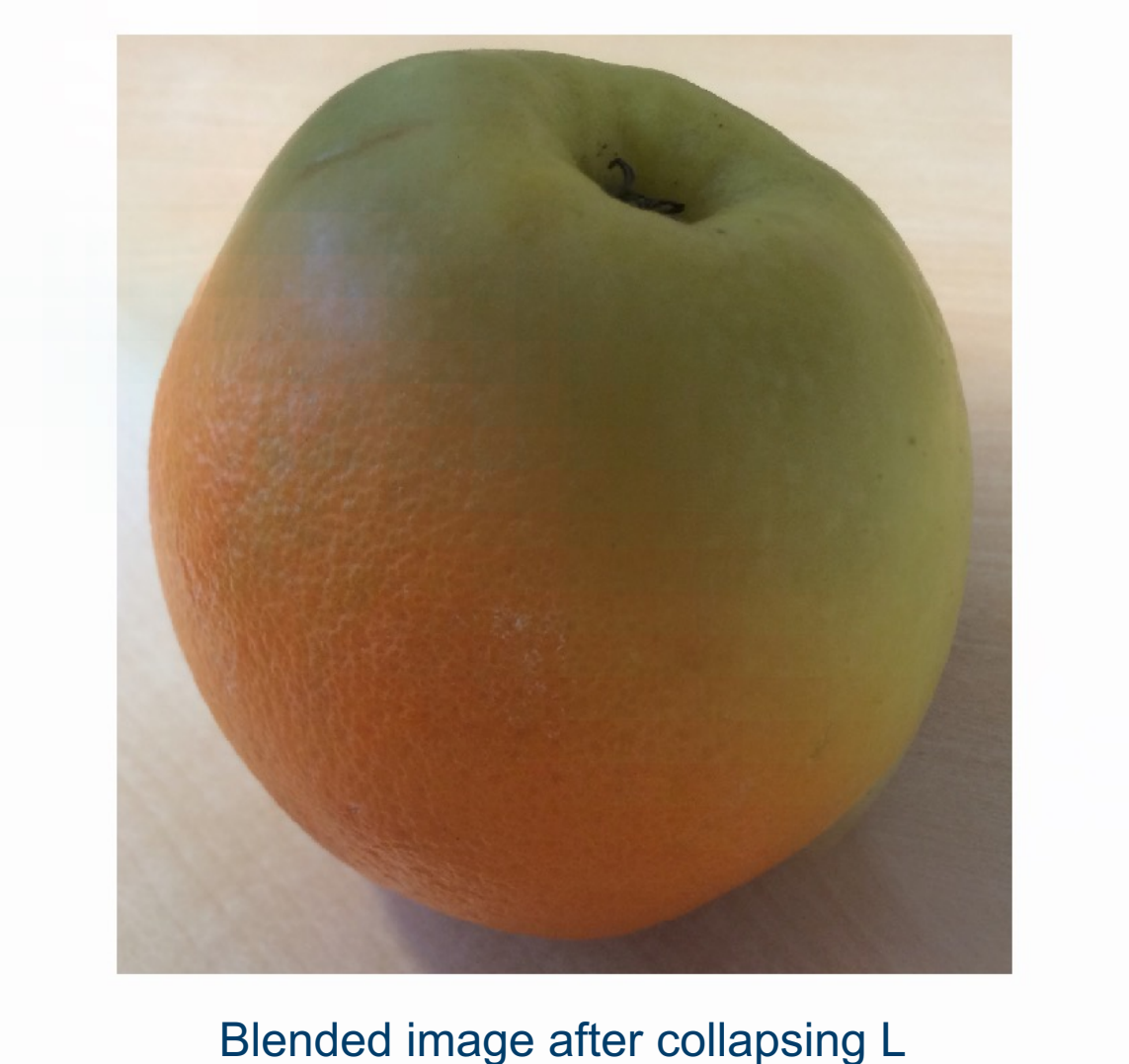
Weighted sum for each level of the pyramid



Laplacian blending



Laplacian Blend (L)



Blended image after collapsing L

Summary

Laplacian Pyramids:

- Laplacian filter
- Laplacian pyramid
- Image blending

Recommended reading:

- Szeliski 3.5

