Reconstructing the original image

- g_n is upsampled by inserting 0s and interpolating the missing value by convolving with w to get g'_{n-1}
- Compute $g_{n-1} = g'_{n-1} + L_{n-1}$
- Repeat till g_0

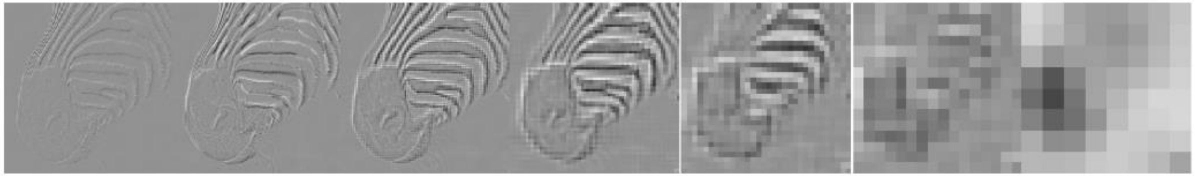
convolution w/ filter.
say Gaussian

$g_0 \leftarrow g_1 \leftarrow g_2 \leftarrow g_3 \leftarrow g_4 \leftarrow g_5 = \left[\begin{array}{l} g'_5 = w * \hat{g}_5 \in \mathbb{R}^{16\times16} \\ + \\ L_5 \end{array} \right.$

upsample.
add zero rows & columns

Note: to create g_5, we needed both g_6 & L_5

L_0 L_1 L_2 L_3 L_4 L_5 g_6



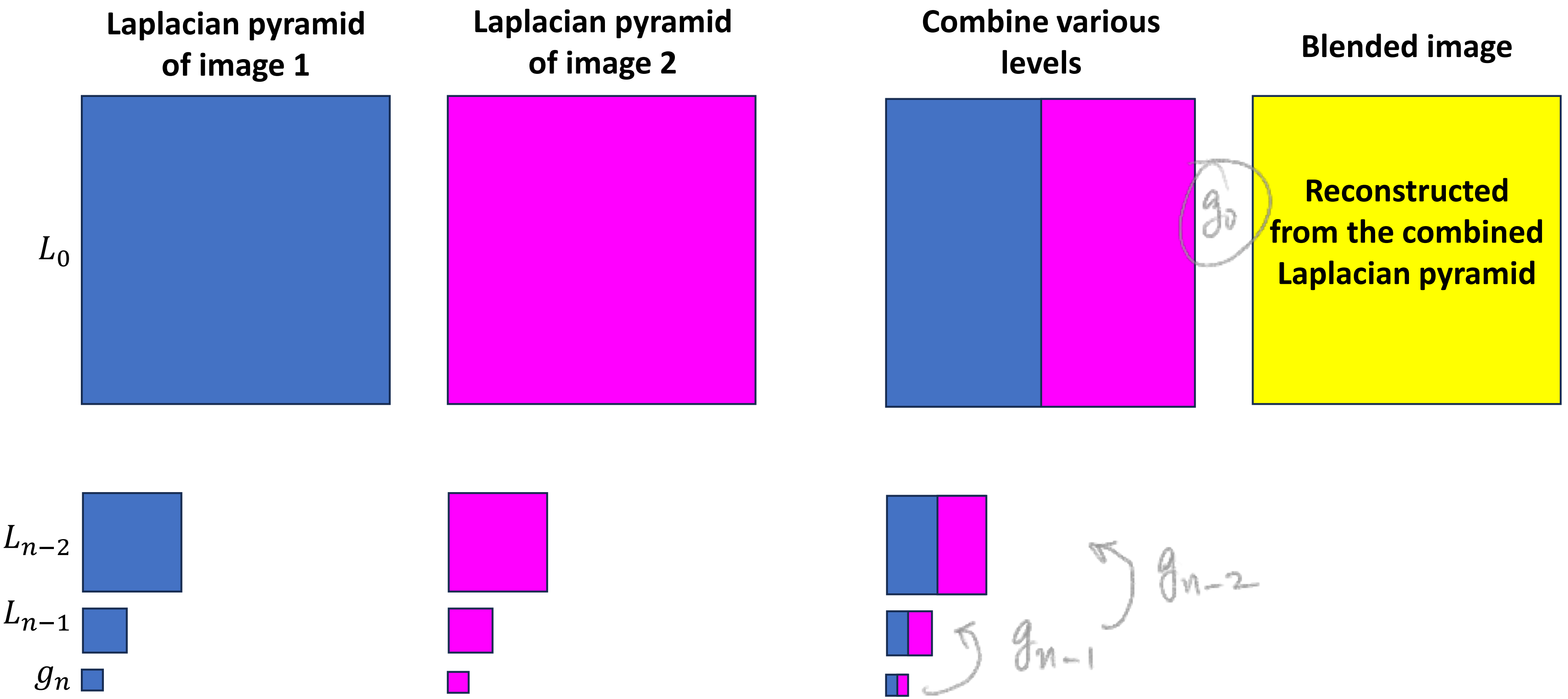
512 256 128 64 32 16 8

$\in \mathbb{R}^{8\times8}$

$\in \mathbb{R}^{16\times16}$

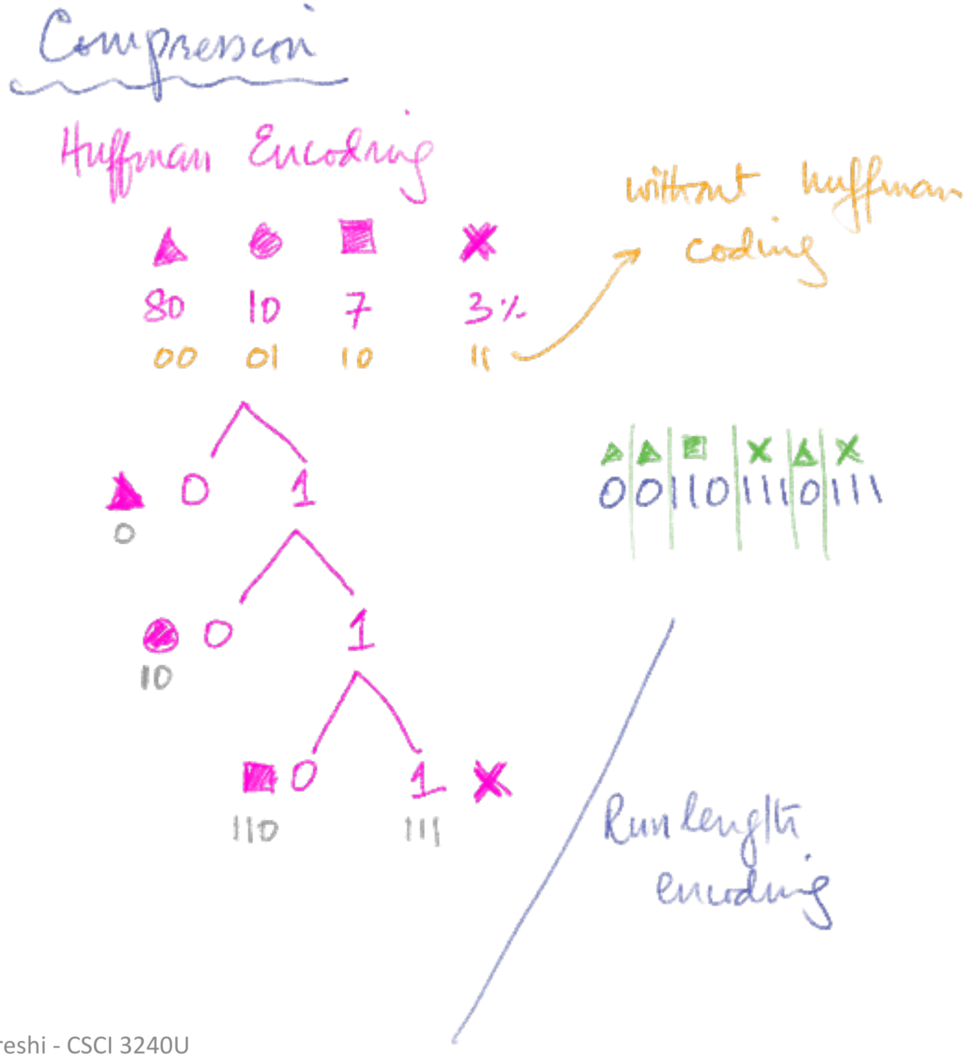
$\boxed{I = L_0, L_1, L_2, \ldots, L_{n-1}, g_n}$

Laplacian blending



Uses

- Scale-invariant image analysis
- Template matching
- Image registration
- Image enhancement
- Interest point detection
- Object detection
- Image compression
- …



Summary

- Gaussian pyramid
  - Coarse-to-fine search
  - Multi-scale image analysis (hold this thought)
- Laplacian pyramid
  - More compact image representation
  - Can be used for image compositing (computation photography)
- Downsampling
  - Nyquist limit: The Nyquist limit gives us a theoretical limit to what rate we have to sample a signal that contains data at a certain maximum frequency. Once we sample below that limit, not only can we not accurately sample the signal, but the data we get out has corrupting artifacts. These artifacts are "aliases".
  - Need to sufficiently low-pass before downsampling

Various image representations

- Pixels
  - Great for spatial processing, poor access to frequency
- Fourier transform
  - Great for frequency analysis, poor spatial info
- Pyramids
  - Trade-off between spatial and frequency information