

Problem H2.4:

(a) Code in zip file.

(b) With *klein-data* and *klein-mask*, we obtain the following results (iteration number: 16310):

initial image	Iteration number: 50000
minimum: 0.00	minimum: 0.00
maximum: 255.00	maximum: 255.00
mean: 5.65	mean: 117.22 (↑)
standard dev.: 27.32	standard dev.: 53.84 (↑)

With *klein-data2* and *klein-mask*, we obtain the following results (iteration number: 14100):

initial image	Iteration number: 50000
minimum: 0.00	minimum: 0.00
maximum: 255.00	maximum: 255.00
mean: 126.19	mean: 117.22 (↓)
standard dev.: 72.64	standard dev.: 53.83 (↓)

We can see there is no difference whatsoever between the 2 versions. This should be expected because we're using the mask to filter out the pixel positions that should not change, and the mask is the same in both examples. Those pixels that do have to change consider the neighboring pixels to obtain their value. As the diffusion process iterates, the less the values that the image started with take importance. But it's worth noting that the first one (black pixels initialization) converged to the final values at $\approx 16,000$ iterations, while the second one (random pixel values initialization) did it at $\approx 14,000$. This is probably due to the fact that the random values initialization has a probability that the random values chosen for a pixel is already close to its original value and thus the iteration process converges faster.

- (c) We found no difference in the 2 reconstructions. That is, the maximum and the average difference were 0.0. On the other hand, the difference between the original image *klein.pgm* and the reconstruction was:
- Average absolute difference: 2.6484
 - Maximum absolute difference: 17

The reconstruction looks like a smoothed-out version of the original image, which makes sense given the process of homogeneous diffusion applied to it. It looks quite like the original image to the naked eye, but it certainly has differences as noted by the *reconstruction_error.pgm*.