Tables and data analysis

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Note: $\|\mathbf{A}\|$ of a matrix $\mathbf{A}$ denotes its Frobenius norm, ie:

$$\|\mathbf{A}\| = \sqrt{\sum_i \sum_j |a_{ij}|^2}$$

1 Tables

1.1 Error by Frobenius norm

Image name	k	$\|\mathbf{A} - \mathbf{A}_{\mathrm{c}}\|$
einstein.png	80	363.79527
einstein.png	40	1168.53798
einstein.png	30	1572.21786
einstein.png	20	2129.10169
einstein.png	10	3250.57103
globe.png	20	3259.34411
globe.png	10	4934.48761
greyscale.png	20	1012.42629
greyscale.png	10	2512.75645
test.png	20	1004.19470
test.png	10	1546.89140

Table 1: Table with images and error

1.2 Error by Frobenius norm per pixel

Image name	k	Resolution	Pixels	$\frac{\|\mathbf{A}-\mathbf{A}_c\|}{\text{Pixels}}$
einstein.png	80	186x182	33852	0.01075
einstein.png	40	186x182	33852	0.03452
einstein.png	30	186x182	33852	0.04644
einstein.png	20	186x182	33852	0.06289
einstein.png	10	186x182	33852	0.09602
globe.png	20	300x314	94200	0.03460
globe.png	10	300x314	94200	0.05238
greyscale.png	20	512x512	100000	0.00386
greyscale.png	10	512x512	100000	0.00959
test.png	20	100x80	8000	0.12099
test.png	10	100x80	8000	0.18637

Table 2: Previous table, but with error per number of pixels

2 Plots and analysis

2.1 Frobenius error

From Fig. 1, we can see that as k increases, the error decreases. This is expected, as a higher value of k means more singular values are retained in the compressed image, leading to a closer approximation of the original image. The relationship appears to be non-linear, with diminishing returns as k increases. One thing to notice though is that this is not consistent across image sizes, which makes sense. As a larger resolution image has a greater number of entries, both its Frobenius norm and the Frobenius norm of the error array should be higher as more entries are included in the sum, and there is no term (for example dividing by the number of pixels) to account for the size of the arrays.

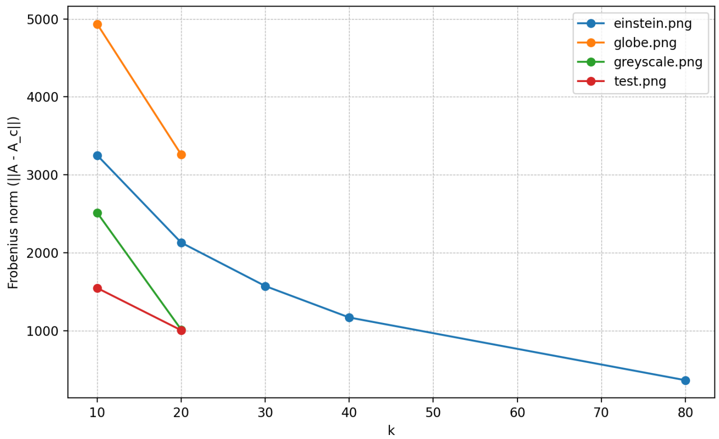

Figure 1: Error by Frobenius norm

2.2 Frobenius error per pixel

From Fig. 2, we can see that as k increases, the error decreases, and this is uniform for all images. This is expected for the same reasons, except in this case no two lines intersect, whereas previously the lines represented by `greyscale.png` and `test.png` seemed to intersect.

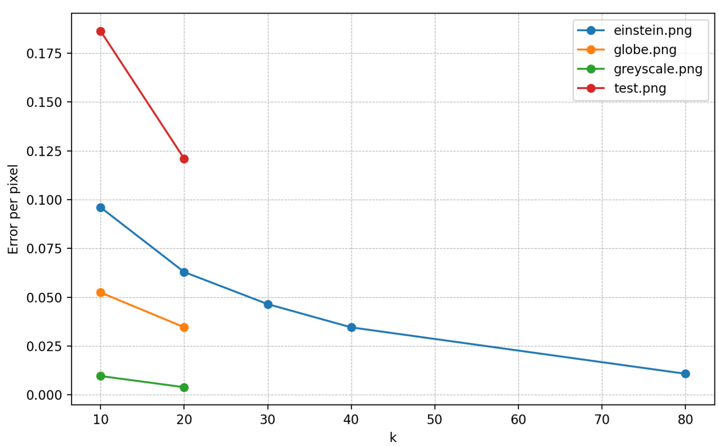

Figure 2: Error by Frobenius norm per pixel