Image compression using k-means clustering algorithm

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Digital Images

Images are represented by pixels and RGB values.
Some cameras use up to 48bits to represent each pixel.
3×16bits for each color 281.5 trillion colors mean a typical 20 megapixel image would require without any compression;

$$48\text{bits} \times 2 \cdot 10^6 \approx 30\text{megabytes}$$

We do not need 281.5 trillion colors in most cases. Most of them are redundant.

Image processing and k-means

k-means can reduce and choose the colors to represent an image.

- Turn the colors used in image into a $2D$ array
- Use k-means on the array to form clusters
- Each cluster is now a color and we can now use k pixels to represent the image

Image processing examples:1

$k = 20$

Image processing examples:2

Grayscale image with $k = 15$ colors

Effect of different k and under/over fitting

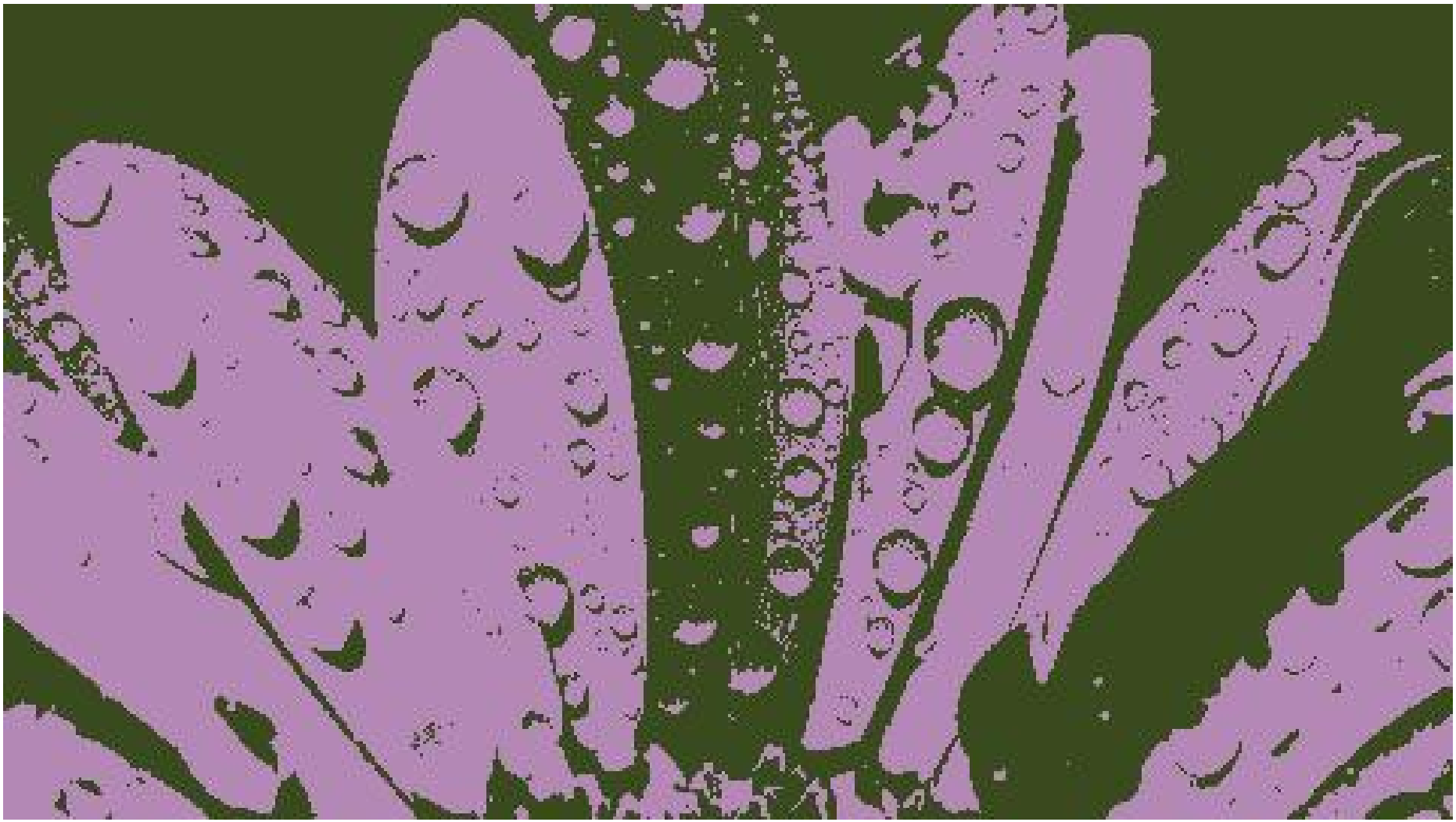
Original Image

Effect of increasing k and under/over fitting

Compressed Image with k=1

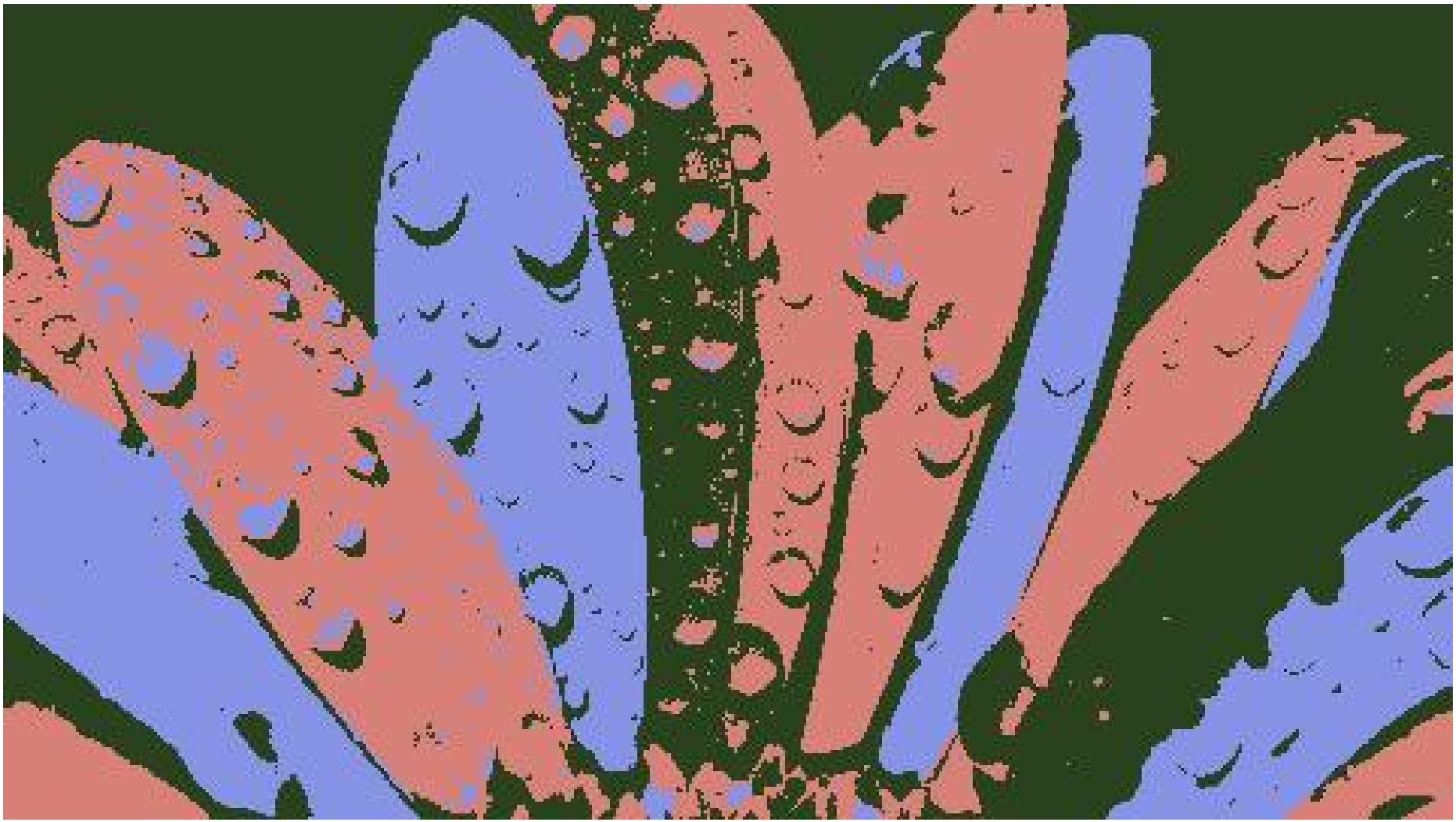
Effect of increasing k and under/over fitting

Compressed Image with k=2



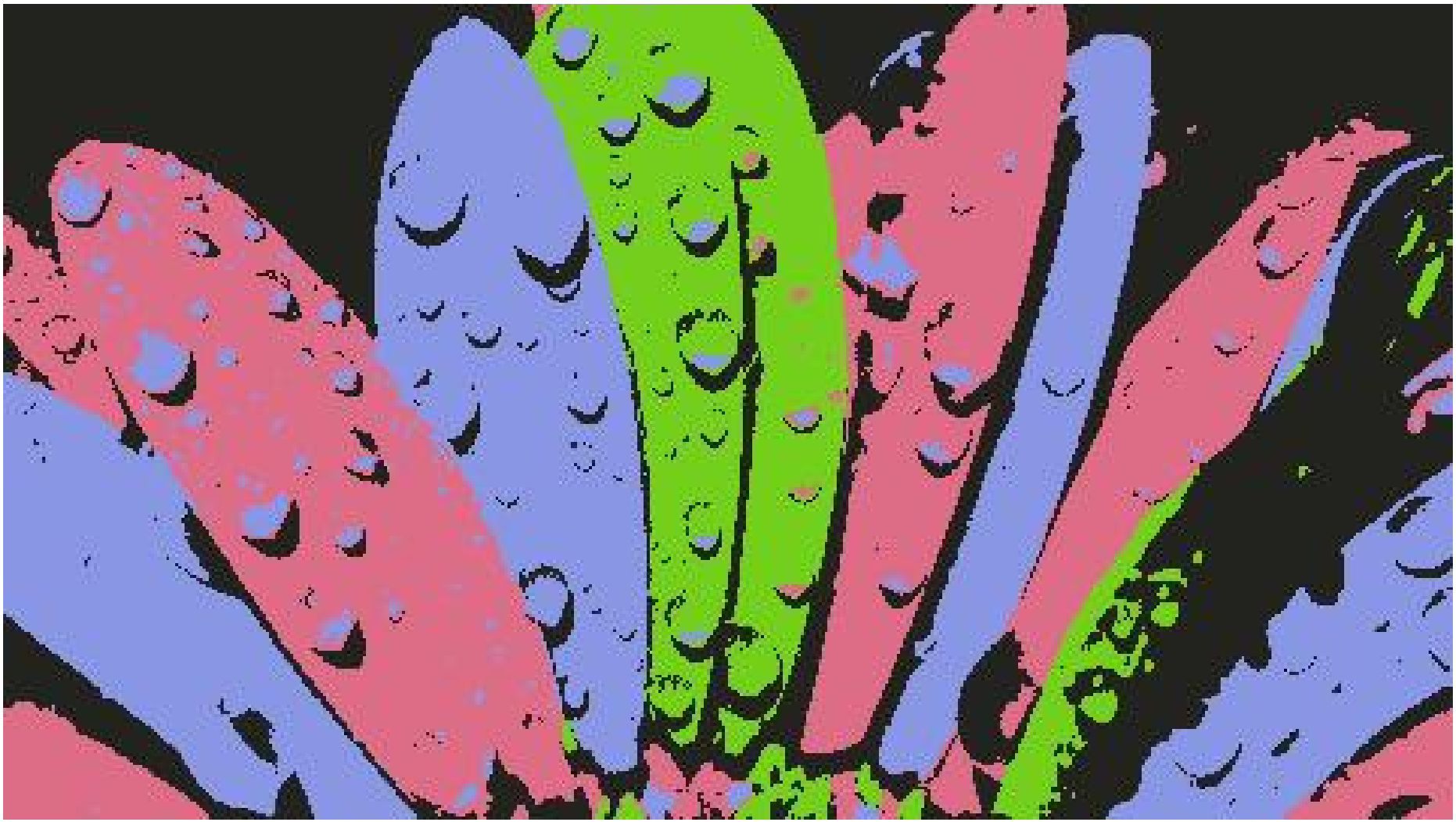
Effect of increasing k and under/over fitting

Compressed Image with k=3



Effect of increasing k and under/over fitting

Compressed Image with k=4



Effect of increasing k and under/over fitting

Compressed Image with k=5, under fit for most situations

Effect of increasing k and under/over fitting

Compressed Image with k=7

Effect of increasing k and under/over fitting

Compressed Image with k=10

Effect of increasing k and under/over fitting

Compressed Image with k=20

Effect of increasing k and under/over fitting

Compressed Image with k=50

Effect of increasing k and under/over fitting

Compressed Image with k=100

Effect of increasing k and under/over fitting

Compressed Image with k=200

Effect of increasing k and under/over fitting

Compressed Image with k=200 and the original


Even with a $k = 200$, data required to represent each pixel reduces to 8 from 48

Original image is compressed to $\approx$ %16 to its size.