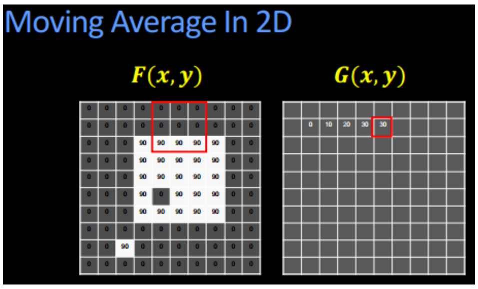
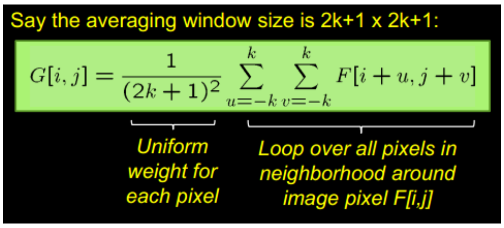
2A-L2-Filtering

2017/11/03 20:23

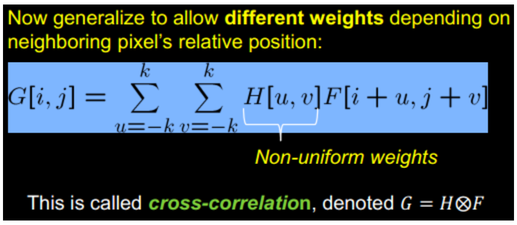
- Sum
  - remove noise in an image - Correlation Filtering
    - average filter
      - average assumptions
    - Gaussian filter
- Remove the Noise
  - intro
    - if we know the noise, we can certainly subtract it but we don't know. Here are some ways to realize it.
  - Alternative 1
    - Replace each pixel with an average of all the values in its neighborhood - a moving average:
    - 3. Averaging Assumptions
      - 1. The "true" value of pixels are similar to the true value of pixels nearby.
      - 2. The noise added to each pixel is done independently
        - so the sum is 0;
  - Alternative 2: 5. Weighted Moving Average
    - generate a smoother result than alternative 1
    - The basic idea is that nearby pixels have similar true underlying values. the closer a pixel is to some reference pixel, the more similar it would be. So the more it should contribute to an average.
    - the To do the moving average computation the number of weights should be Odd and symmetric - makes it easier to have a middle pixel
    - the sum of the weight should be 1
- 8. Moving Average In 2D
  - use a squared region to calculate the average



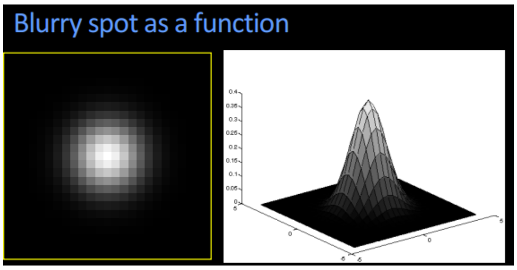
- Questions
    - how to deal with the edge?
- this is called [9. Correlation Filtering]
    - uniform weights



    - non-uniform weights



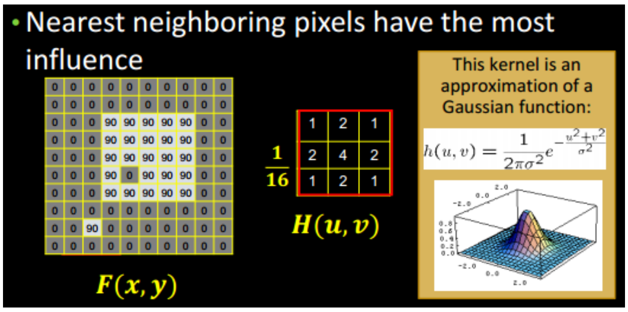
    - The filter “kernel” or “mask” H[u,v] is the matrix of weights in the linear combination.
        - this kernel is different from the one in ML
- what makes a good kernel?
    - Alternative 1: Averaging Filter - uniform one
        - the result is really bad
        - what’s the problem
            - squares aren’t smooth
            - And filtering an image with a filter that is not “smooth” seems wrong if we’re trying to “blur” the image.
        - analogy
            - think about what a single spot of light viewed by an out of focus camera would look like.



- so To blur a single pixel into a “blurry” spot, we would need to need to filter the spot with Something that looks like a blurry spot - higher values in the middle, falling off to the edges

◦ Alternative 2 - Gaussian Filter

- we get sth so much better - no clear edges in the image



- Key
  - nearest neighboring pixels have the most influence
- called: circularly symmetric Gassian function or isotropic
- formula

$$h(u,v) = \frac{1}{2\pi\sigma^2}\exp\left(-\frac{x^2+y^2}{2\sigma^2}\right)$$

- The amount of smoothing is define by the Variance or Standard Deviation (sigma), the only parameter in the isotropic funciton
- another influential parameter, the size of the kernel/square
  - the bigger one with the same sigma has better performance

- the kernel has to be big enough, it's a default parameter. So often a "big kernel" means a "big sigma" actually

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- 15. Matlab code

```
sigmav = [3, 13, 23, 33];
for sigma = sigmav
  hsize = 31;
  h = fspecial('gaussian', hsize, sigma);
  out = imfilter(nmona, h);
  figure(sigma);imshow(out);
end
```

- 16. Quiz: Remove Noise
    - the Gaussian filter can smooth/blur the image but it affect the original image, too. so you don't get back exactly the same as the original one.
    - even through the smoothed image doesn't look good virtually, but it benefits the image process a lot.
- 17. Quiz: Gaussian Filter Quiz
  - When filtering with a Gaussian, which is true:
    - The sigma is most important - it defines the blur kernel' s scale with respect to the image
    - Altering the normalization coefficient does not effect the blur, only the brightness.
- 18. Keeping the Two Gaussians Straight
  - when talking about Gaussian filter, sigma defines a width of a the Gaussian filter.
  - when talking about Gaussian noise, sigma defines the variance of a noise function or the value of the noise. The bigger the noise sigma was the more likely that large values of noise can be created.