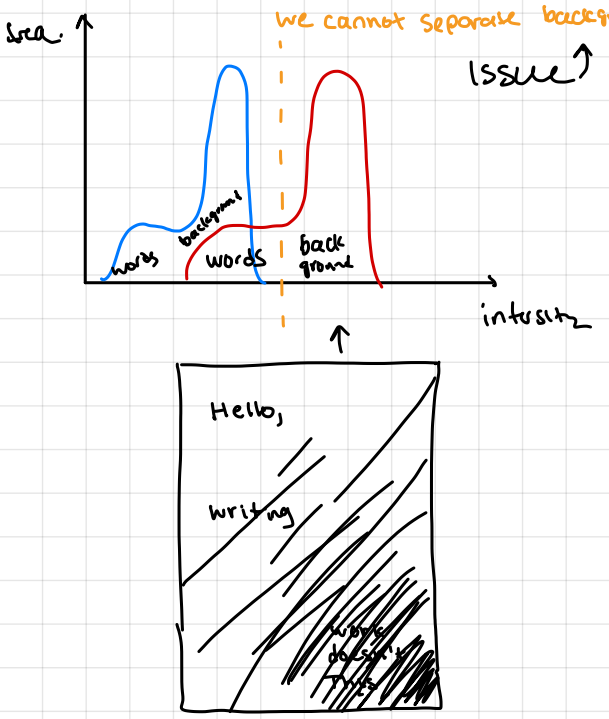
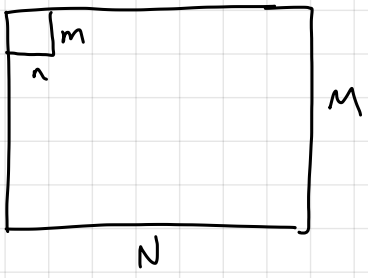
Adaptive Histogram Equalization - 1/23/2020



- apply different functions to different parts of image
- do histogram equalization in patches
- issue → edges formed by applying different transformations to different images
- solution: do it pixel by pixel?

① Compute hist. of surrounding pixels
② histogram equalization
③ replace pixel

- computing histogram is $O(nm)$
- doing hist eq is $O(nm)$



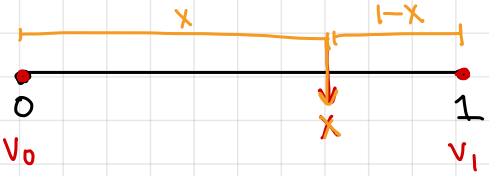
- doing this pixel by pixel

$O(nmNM)$:(

- doing it block by block
  - $O(NM)$ b/c just breaking up image & doing same thing over

Better way: bilinear interpolation

Linear interpolation:

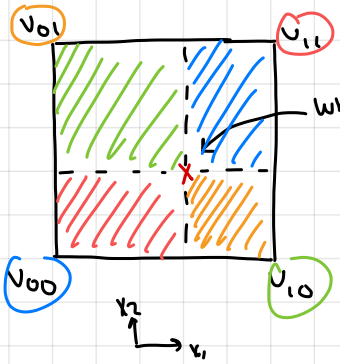


$V_i = f(X_i)$

$V(x) = xV_1 + (1-x)V_0$

value @ x

Bilinear interpolation



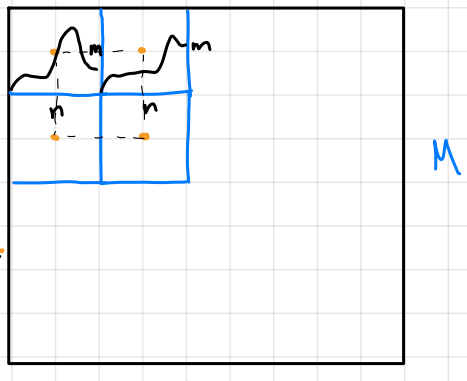
$$V(X) = x_1 x_2 V_{11} + x_1(1-x_2)V_{10} + (1-x_1)x_2 V_{01} + (1-x_1)(1-x_2)V_{00}$$

Adaptive Hist Eq with bilinear interpolation:

X_{ij} : orig intensity
y_{ij} : resulting one
f_{ij} : transform fn @ ctr of window

$$y_{ij} = x_1 x_2 f_{Lij} + x_1(1-x_2) f_{ij}$$

↑ fn to left of y



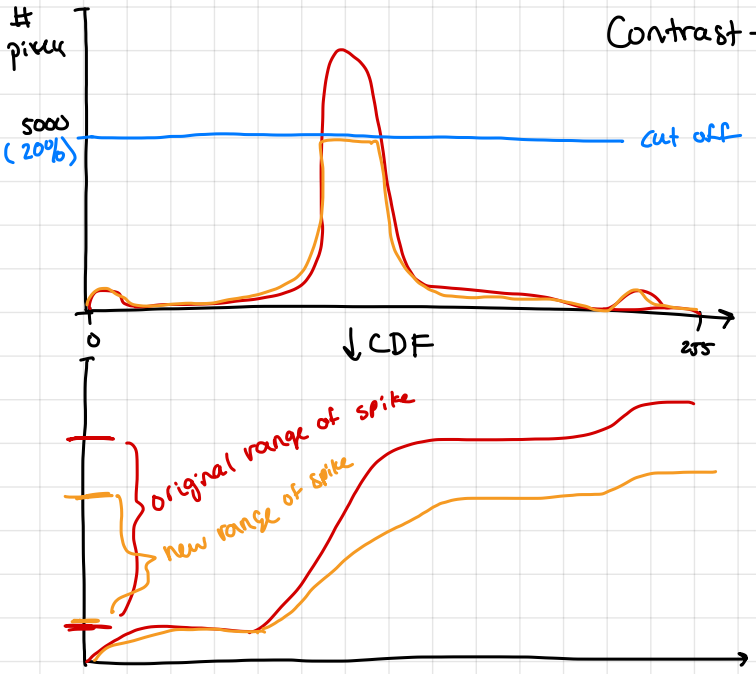
- apply transformations of surrounding blocks in prop to dist from centers of surrounding blocks
- how does block sizing help/hurt?

Issues with histogram equalization

- amplification of noise
- introduces contrast
  but what if it introduces contrast where we shouldn't be?
  ↳ even worse with adaptive hist eq.
- Photo of wall:

Looks like not a wall but gravel now

Determining areas of low contrast that we don't to amplify



Contrast-limited adaptive histogram equalization (CLAHE)
↳ solves book problem

- high slope means we are stretching mapping out
- limiting height of dist limits slope and thus the spreading out of intensity and thus the contrast