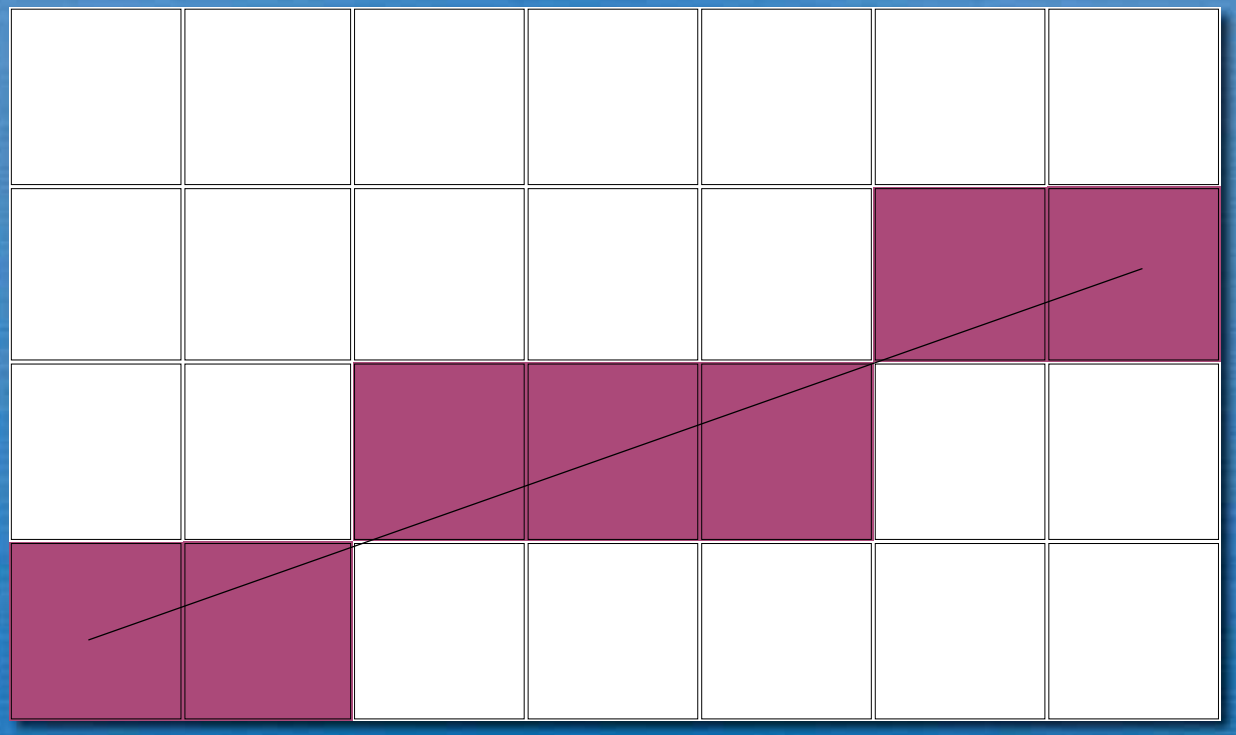
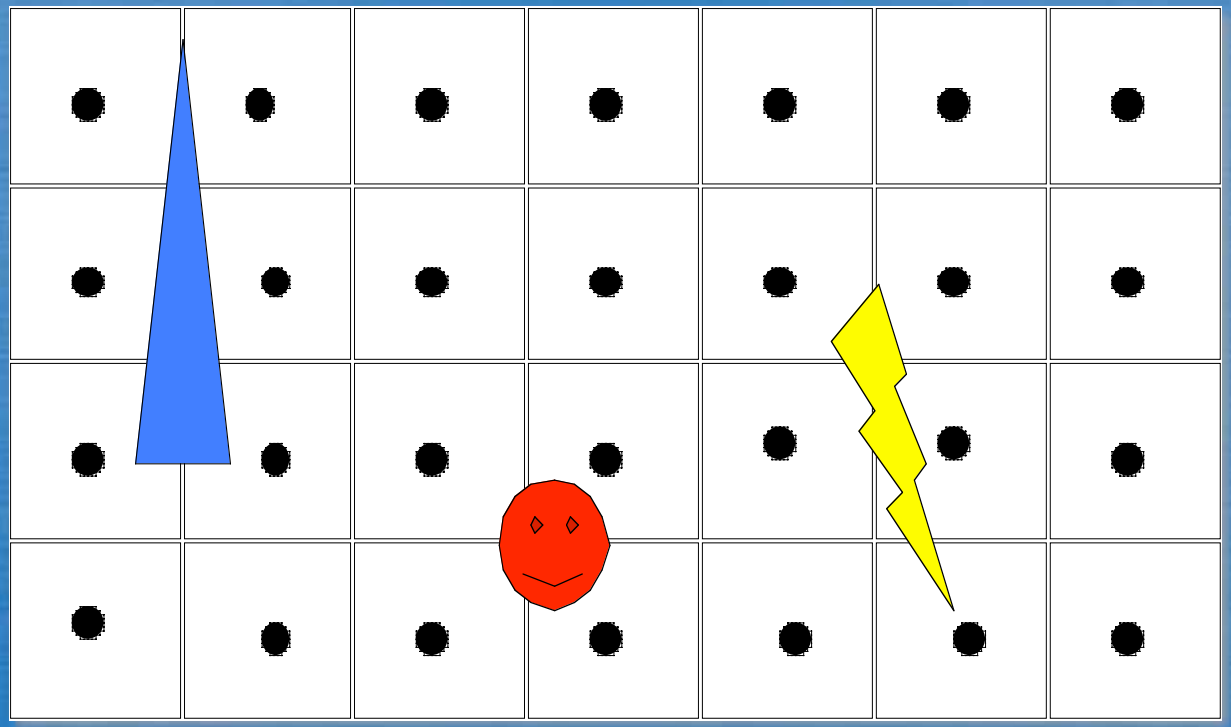
CMSC 435

Antialiasing

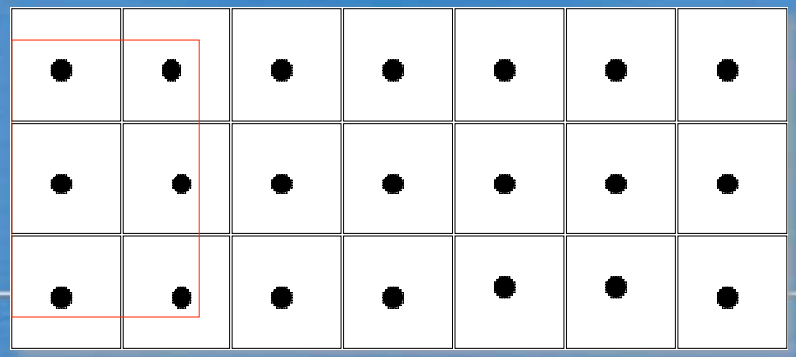
Aliasing

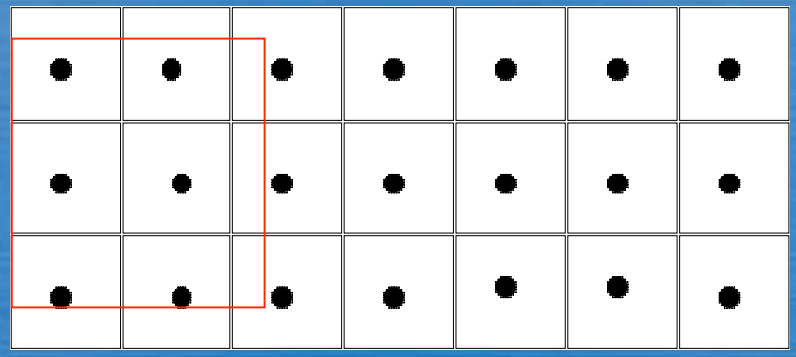
- Visual artifacts
  - jagged lines and edges
  - high frequencies appearing as low
  - small objects missed
  - texture distortions
  - strobing and popping
  - backward movement

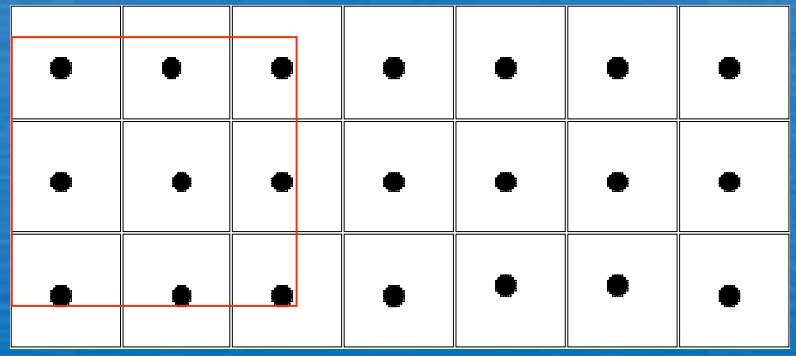




No antialiasing



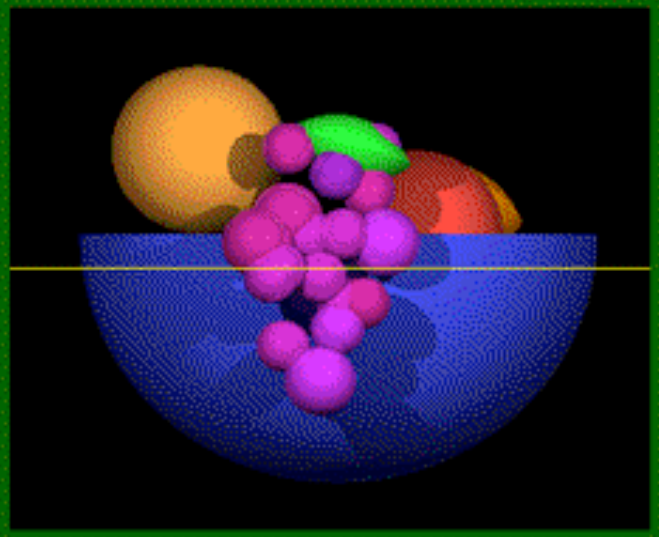




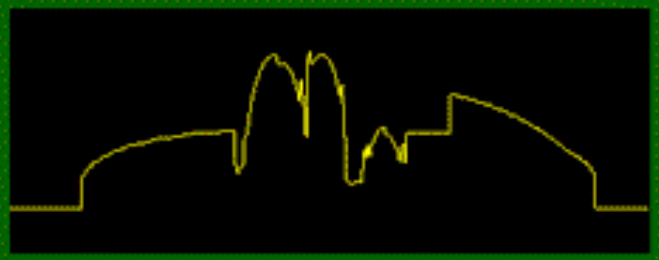
Rendering Process

- Two basic stages
  - sampling
  - reconstruction

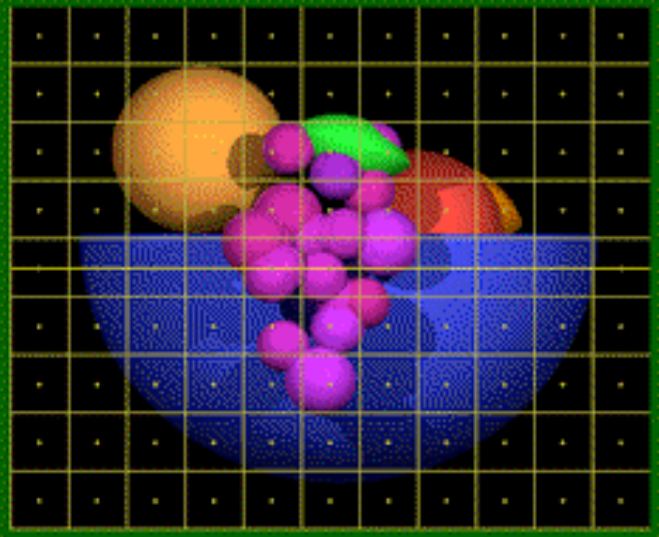
- Assuming discrete sampling



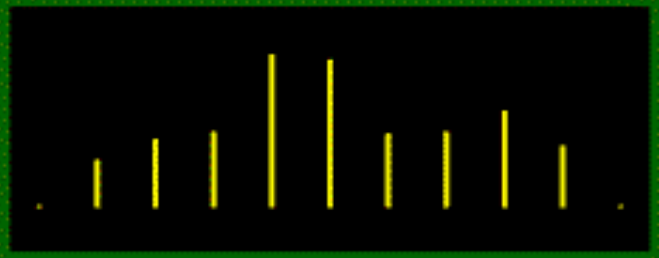
Original scene



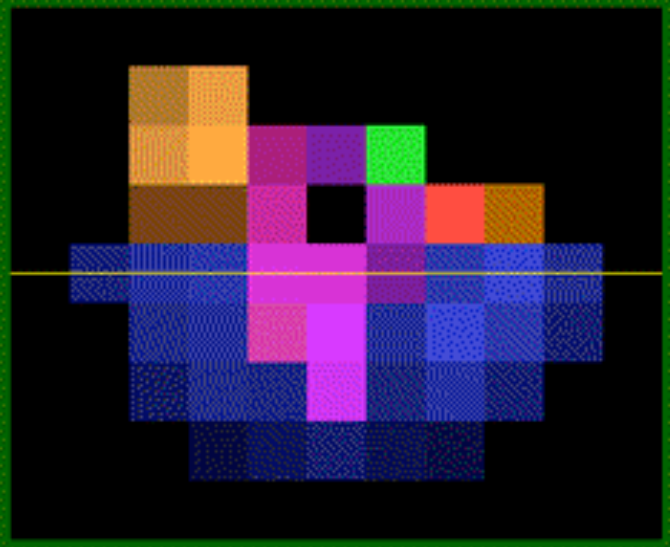
Luminosity signal



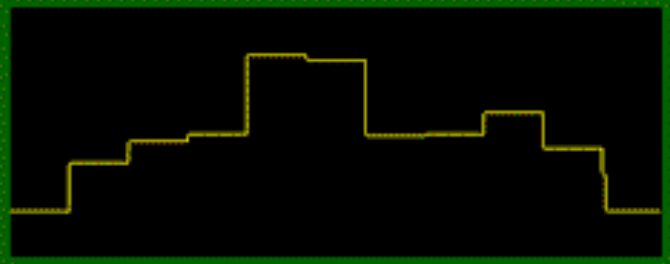
Sampling at pixel centers



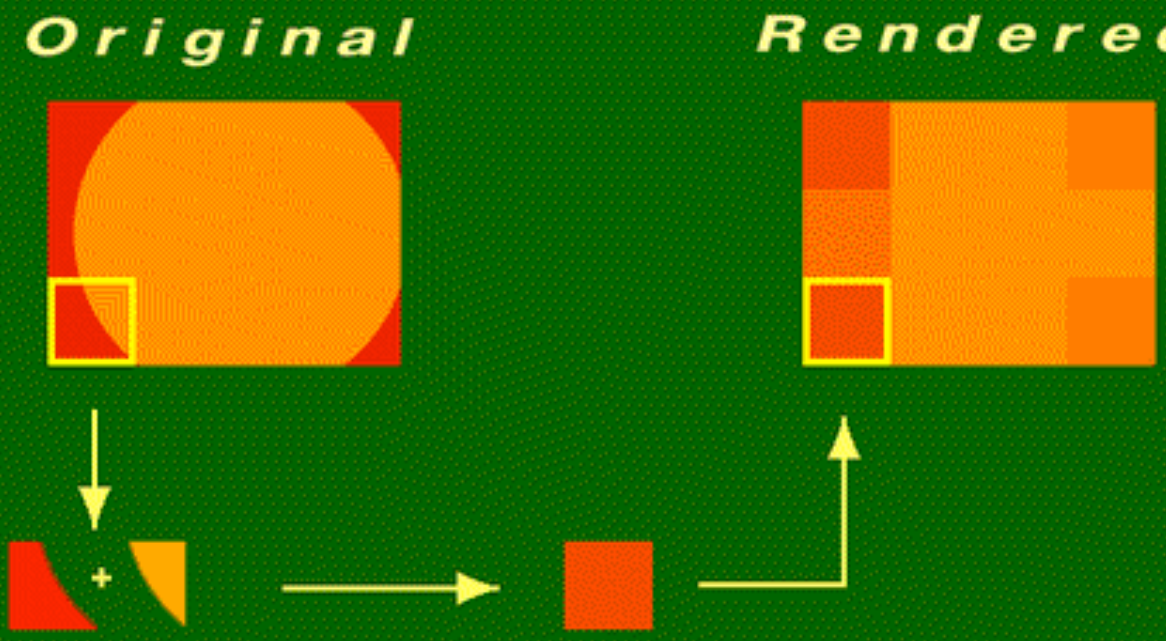
Sampled signal



Rendered image

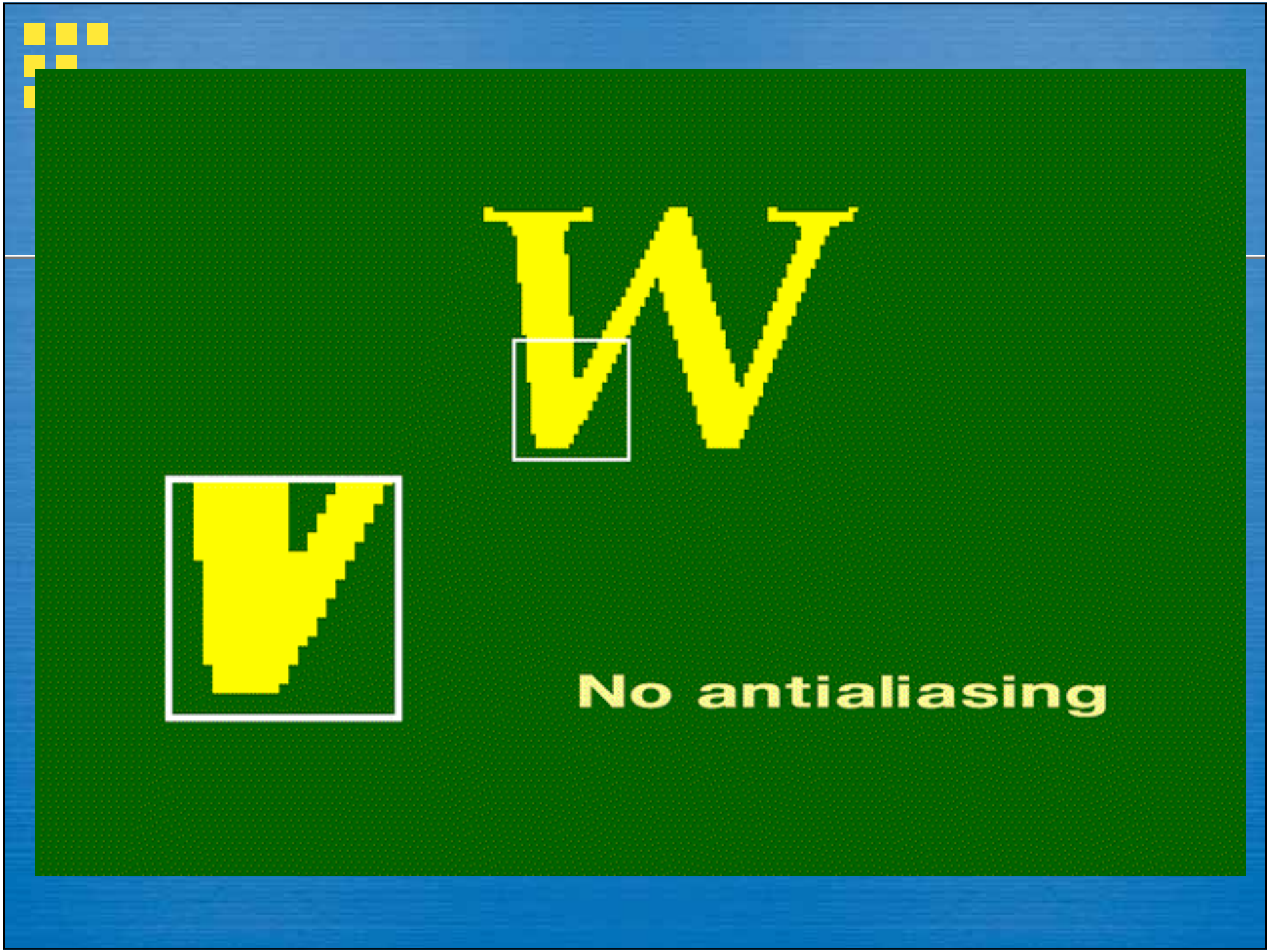


Luminosity signal



Prefiltering methods examine areas of color within a pixel.

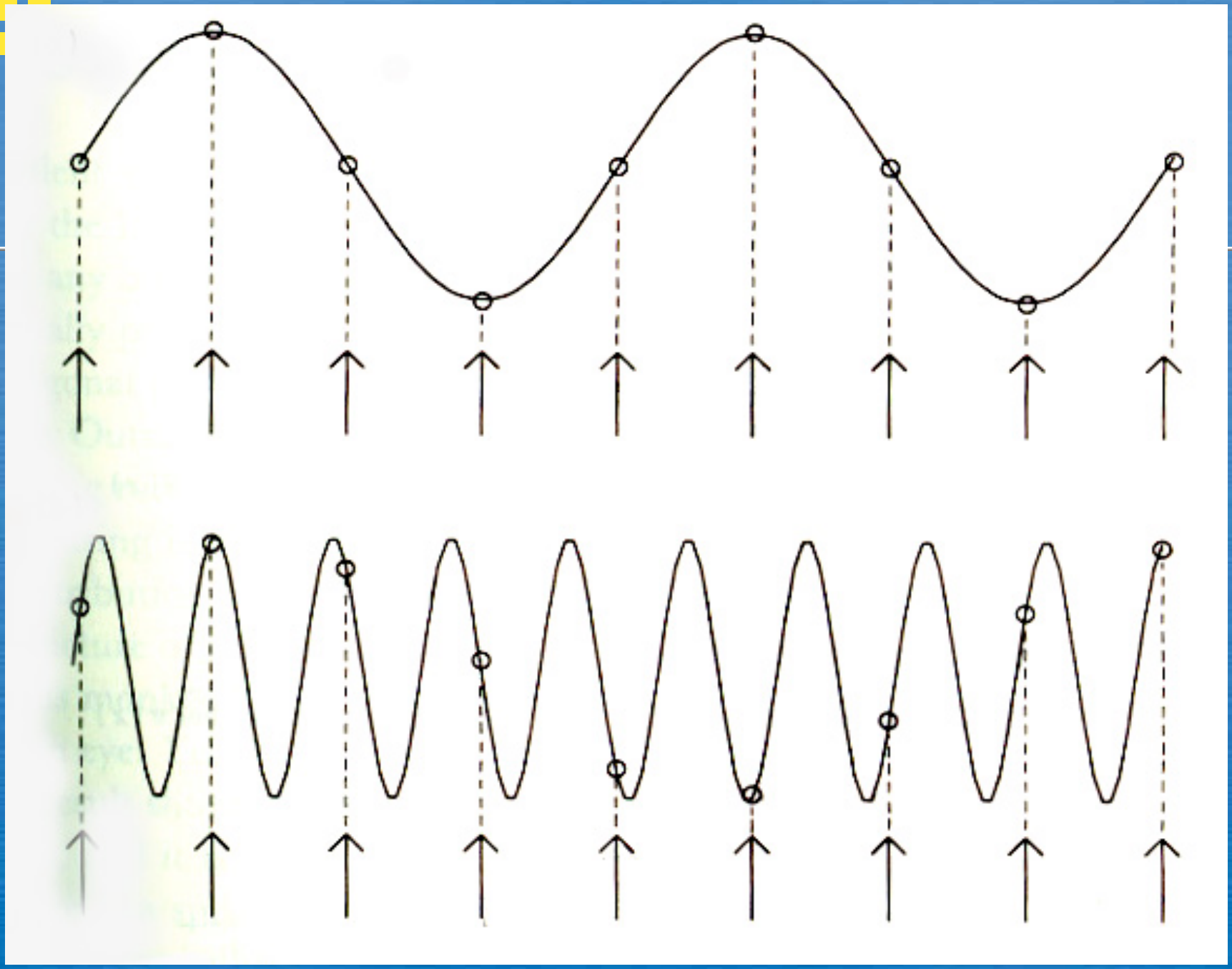
Hello World
Hello World
A demonstration


No antialiasing

Prefiltering

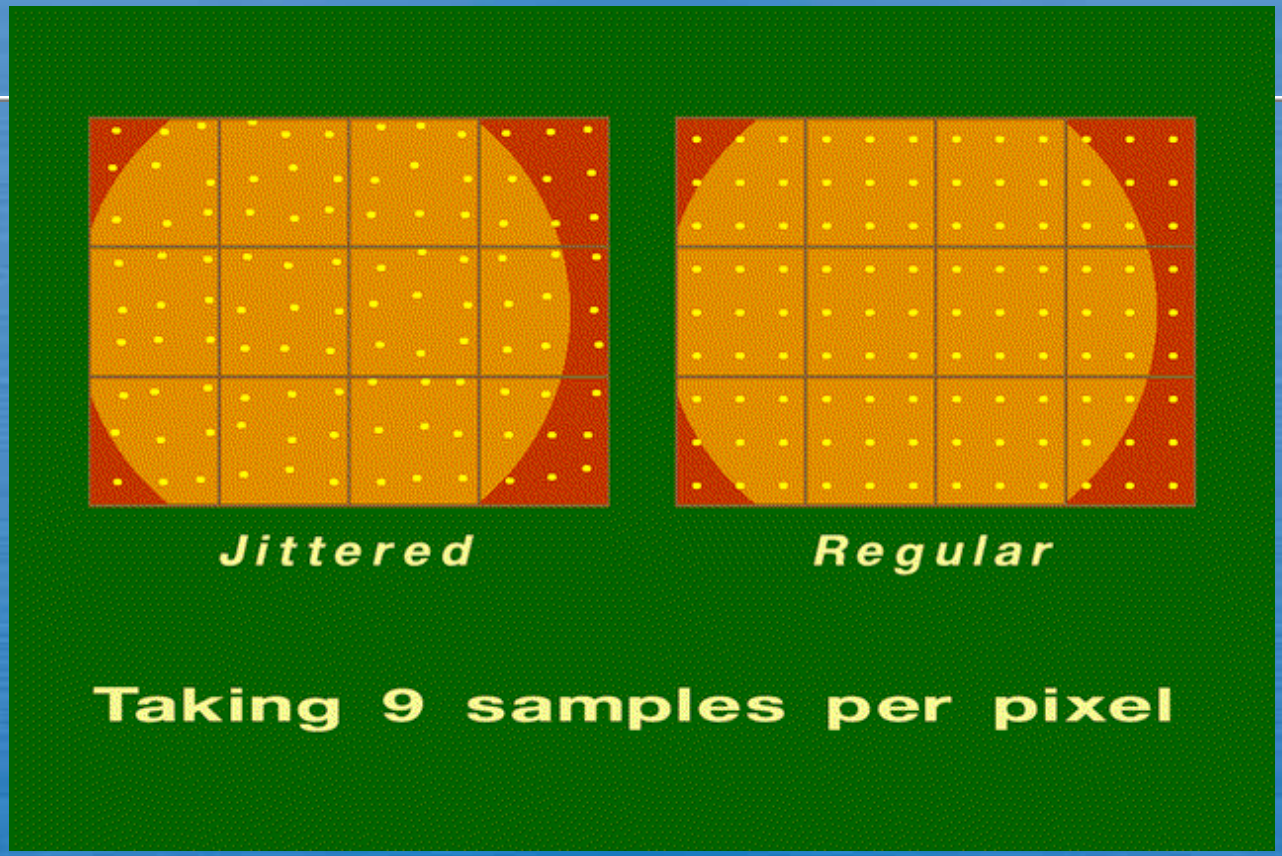
Sampling Theory

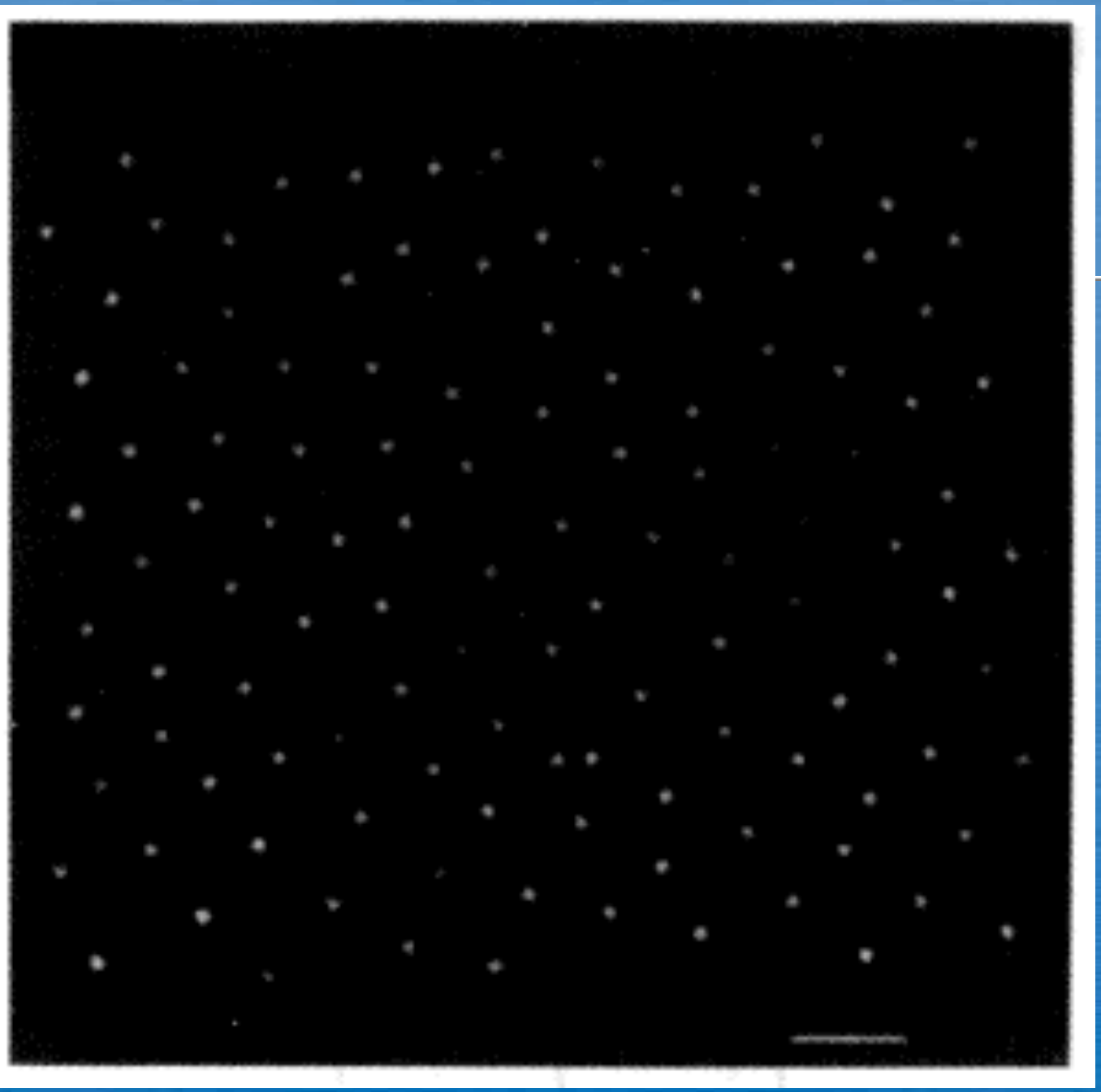
- Shannon's sampling theory (1D):
  - A band limited signal f(t) with cut off frequency w_F may be perfectly reconstructed from its samples $f(nT_0)$ if $2\pi/T_0 >= 2w_F$
  - w_F == Nyquist limit
- Alternatively:
  - a signal can be reconstructed exactly from samples only if the highest frequency is less than half the sampling rate



Sampling Schemes

- Regular supersampling
- Jittered supersampling
- Adaptive supersampling
- Stochastic sampling


Jittered
Regular
Taking 9 samples per pixel



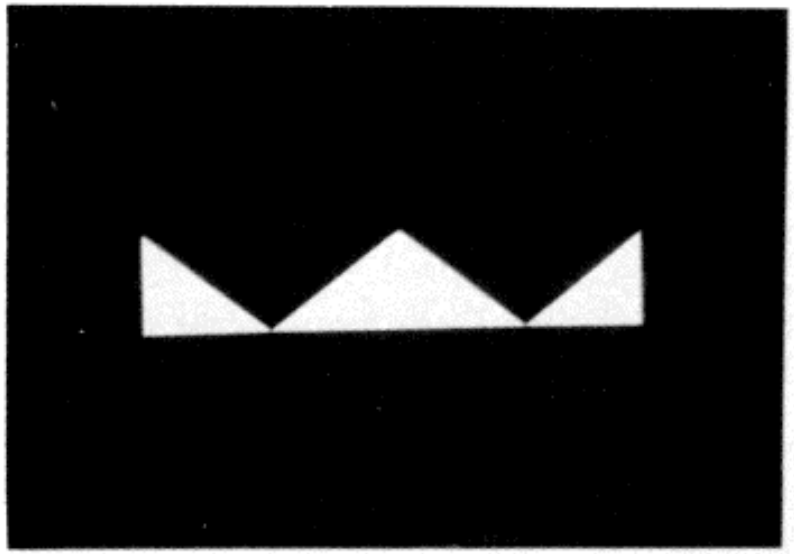


Fig. 12c. Comb rendered with a regular grid, one sample per pixel.

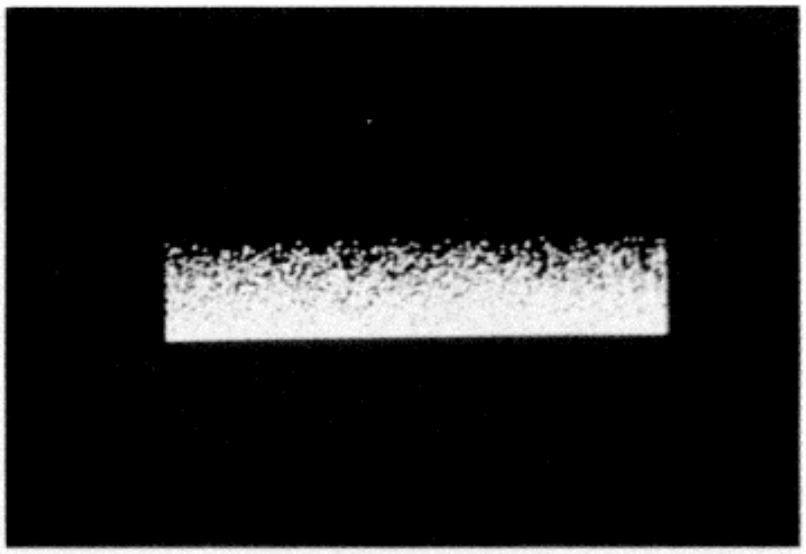
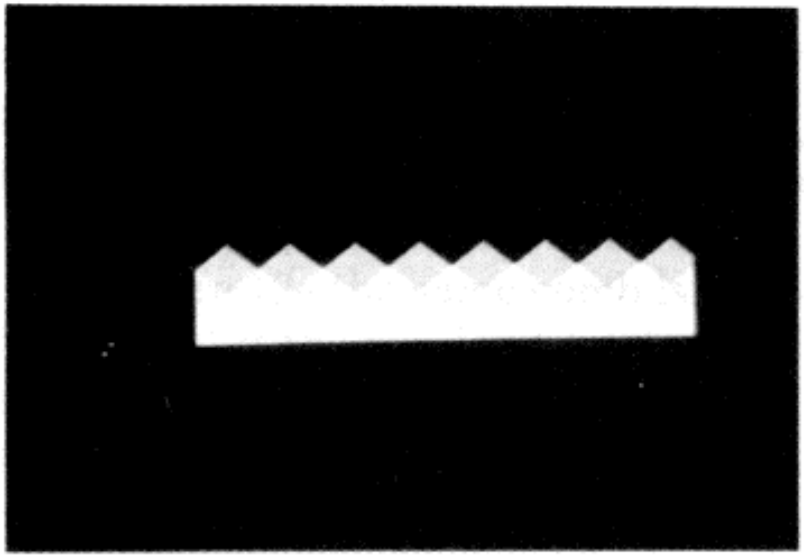
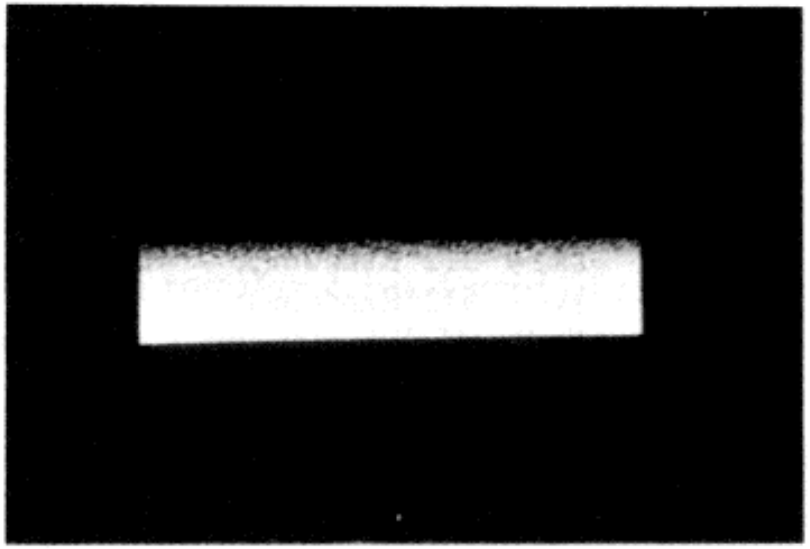
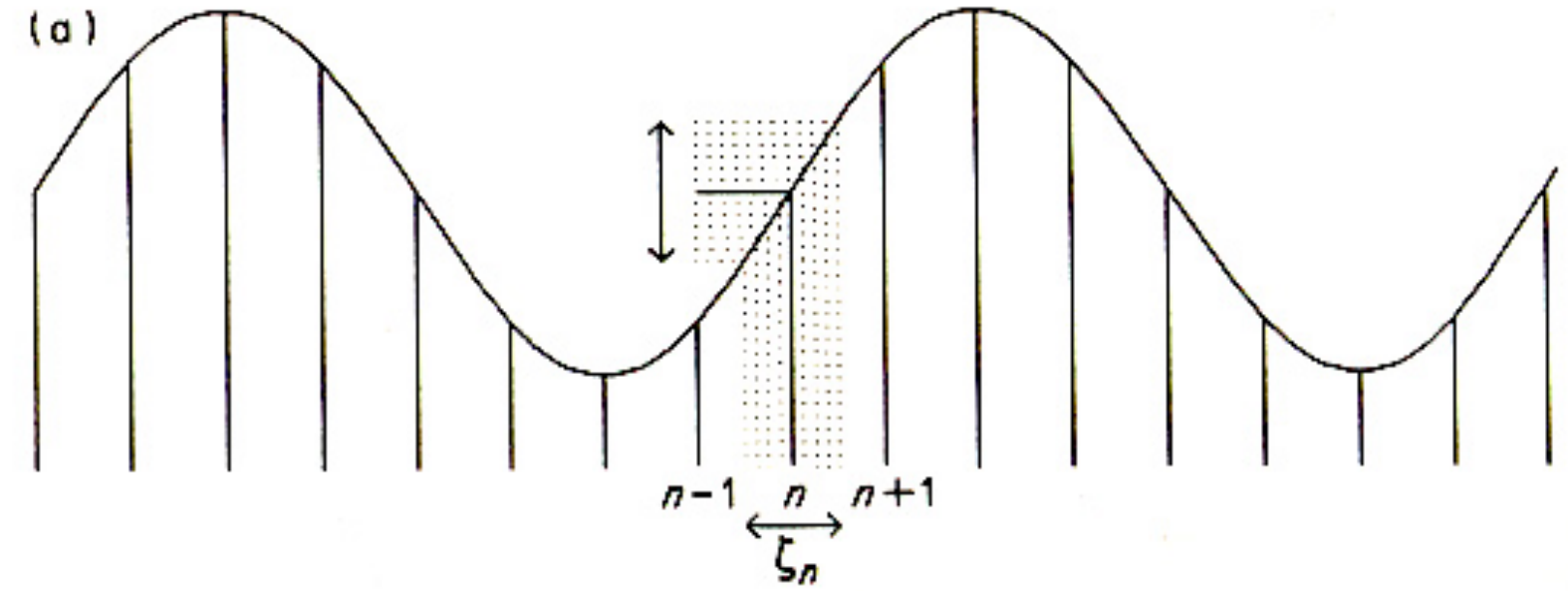
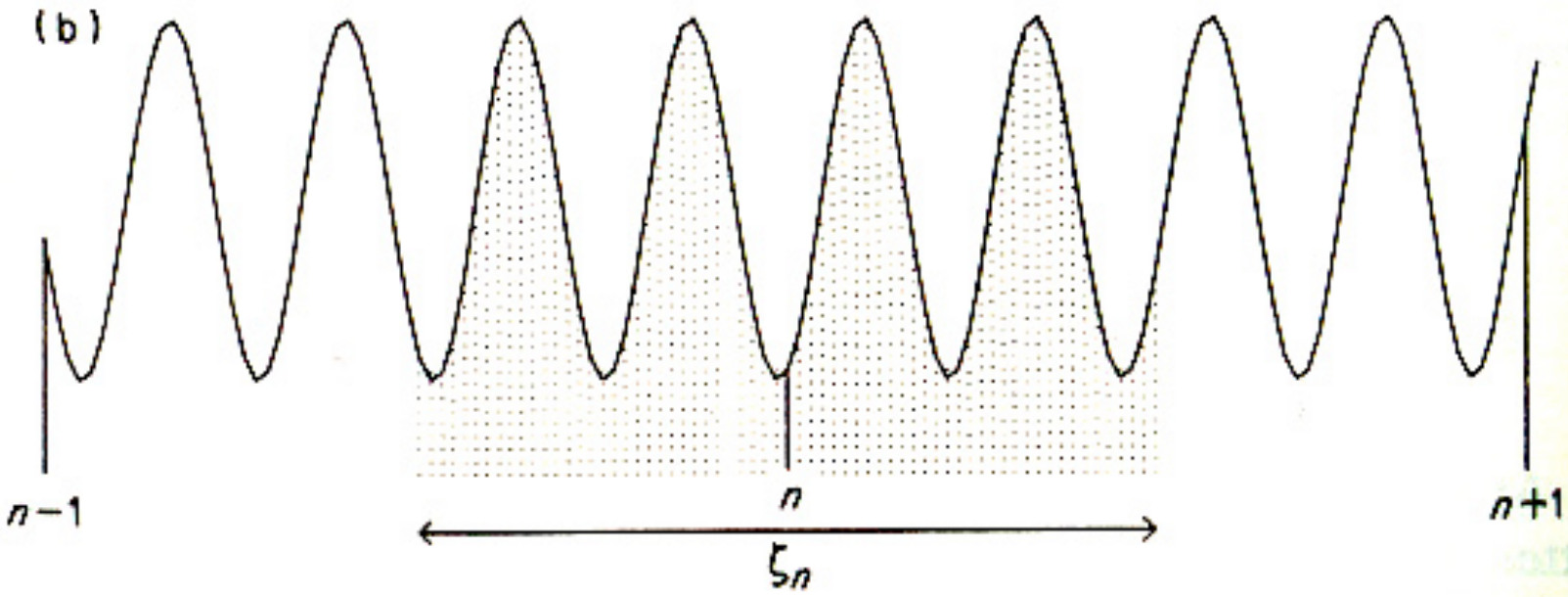


Fig. 12d. Comb rendered with a jittered grid, one sample per pixel.



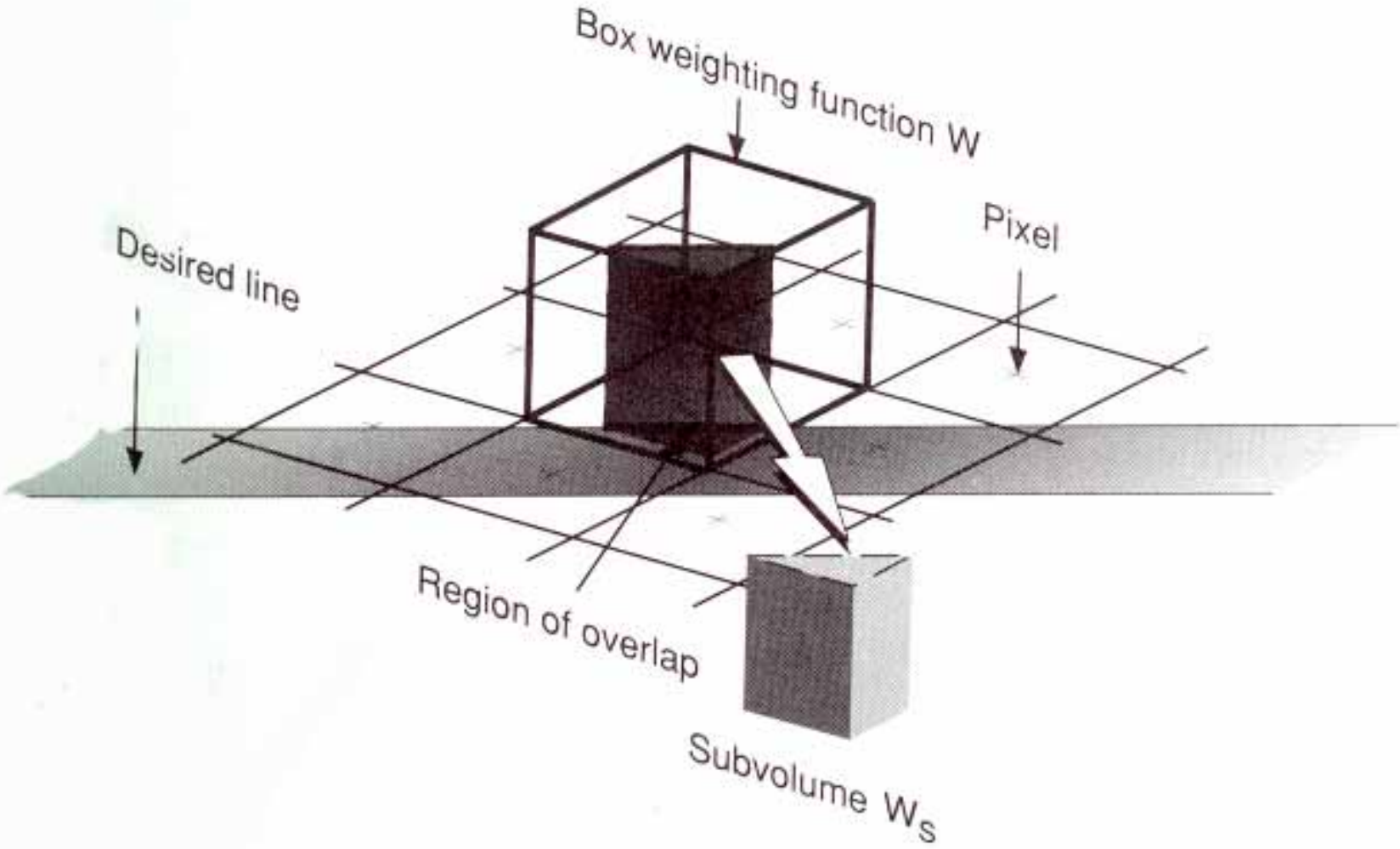


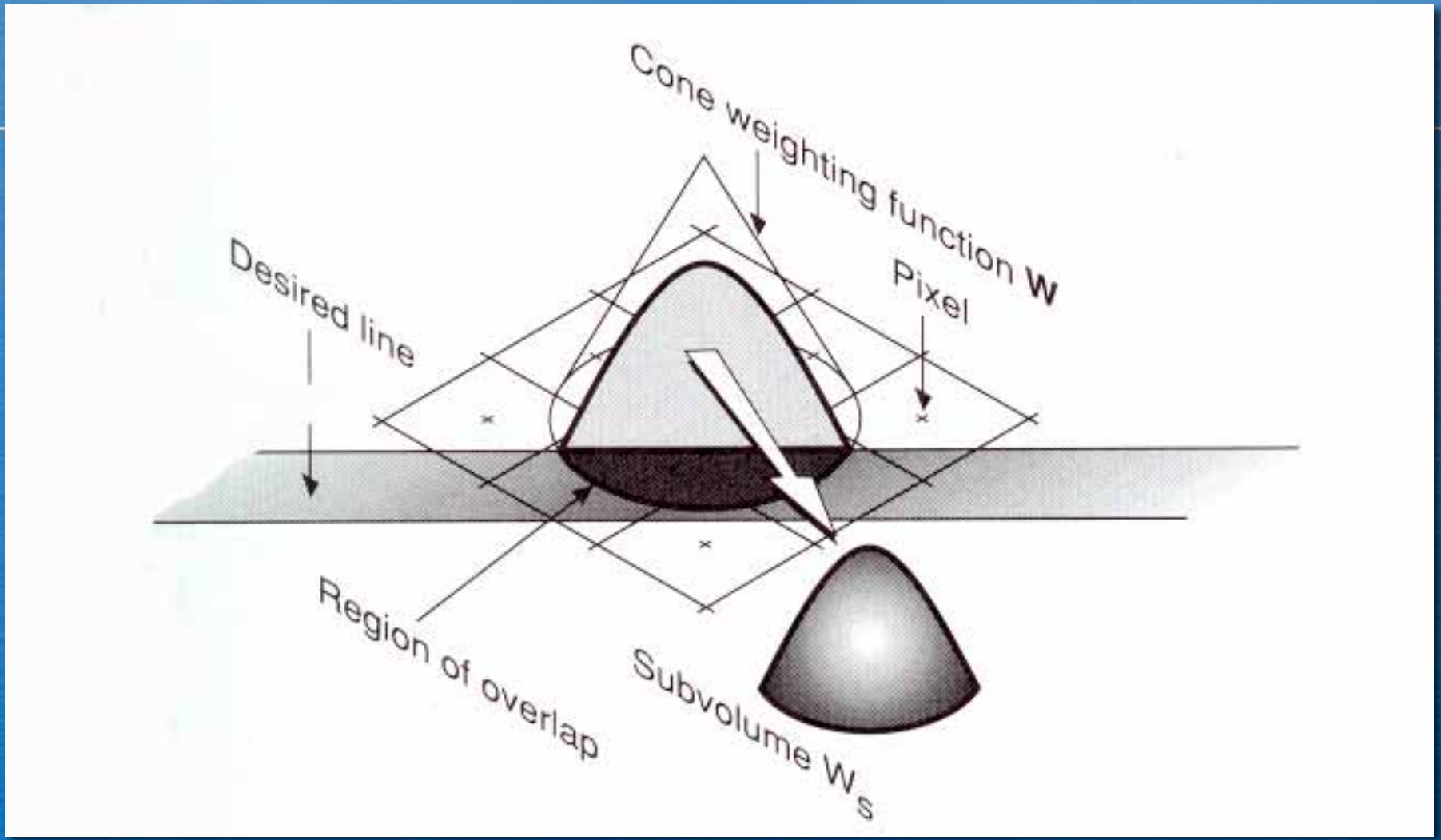

(a)
n−1
n
n+1
ζn

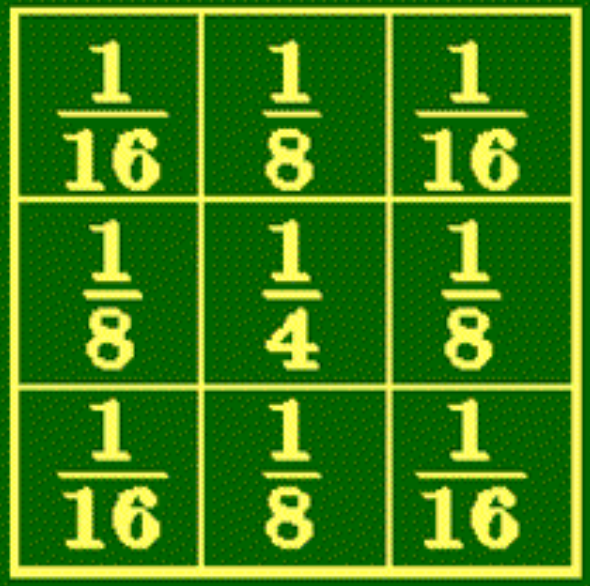

(b)
n−1
n
n+1
ζn

Reconstruction

- Reconstruction: recreate a continuous signal from a set of samples
- Tasks of reconstruction filter
  - remove extraneous replicas of signal spectrum
  - pass the original signal base unchanged


Box weighting function W
Pixel
Desired line
Region of overlap
Subvolume W_s


Cone weighting function W
Pixel
Desired line
Region of overlap
Subvolume W_s



Combines nine samples

Filters combine samples to find a pixel's color.

This filter computes a weighted average.

Samples *Pixels*

No antialiasing

3x3 supersampling
3x3 unweighted filter

3x3 supersampling
5x5 weighted filter

3x3 jittered supersampling
5x5 weighted filter