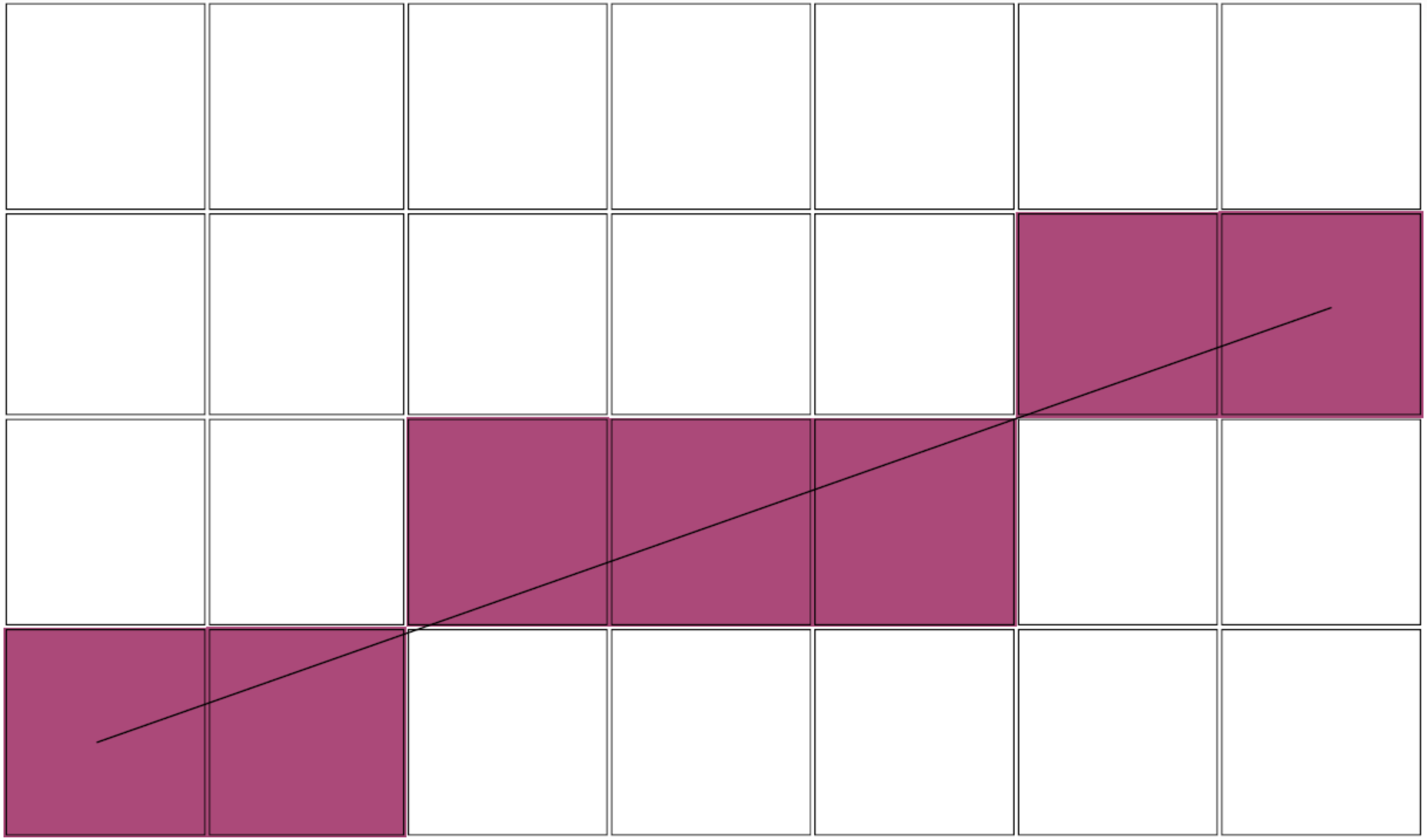
Antialiasing

Aliasing

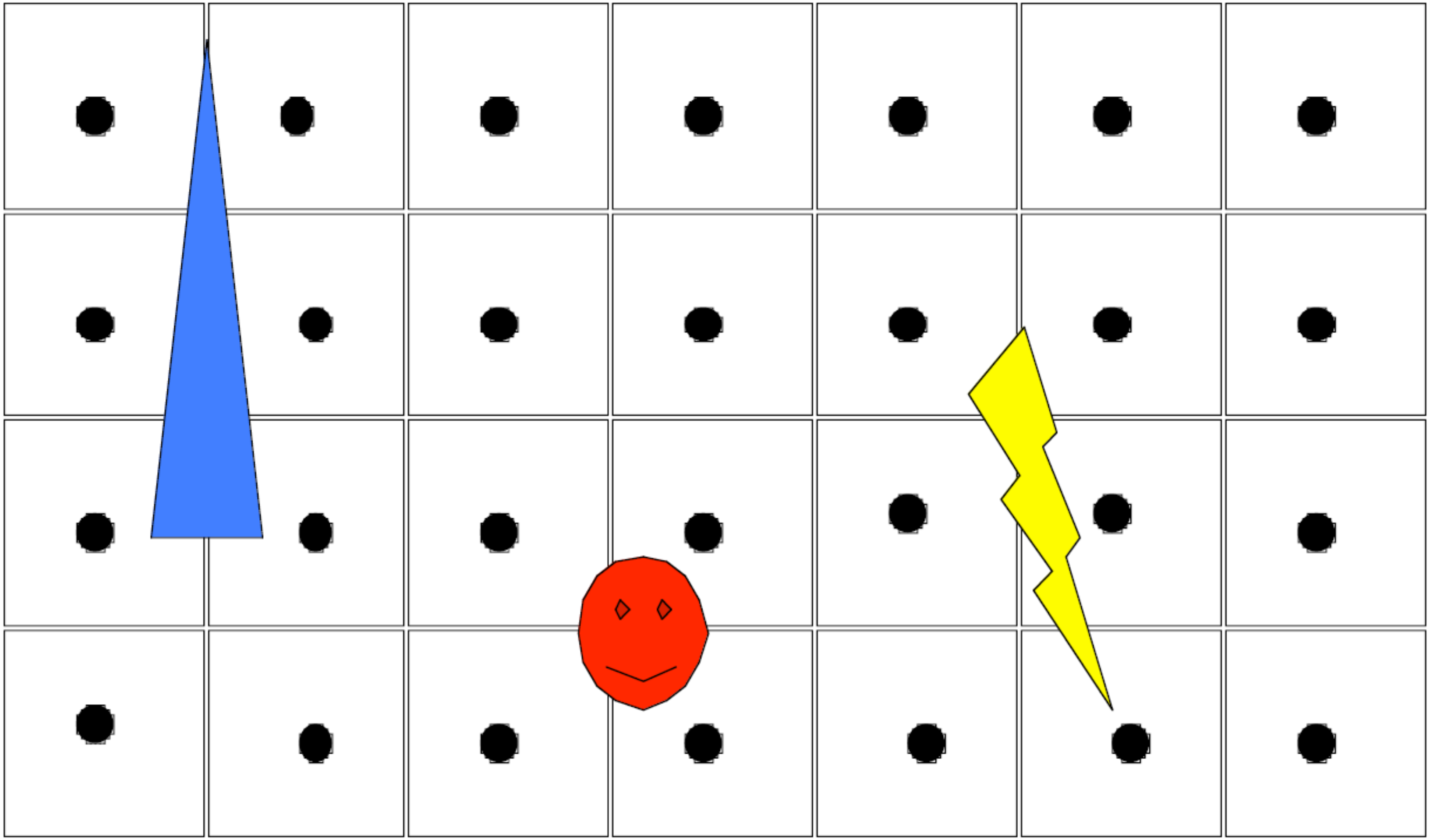
- Visual artifacts
  - Jagged lines and edges
  - High frequencies appearing as low
  - Small objects missed
  - Texture distortions
  - Strobing and popping
  - Backward movement

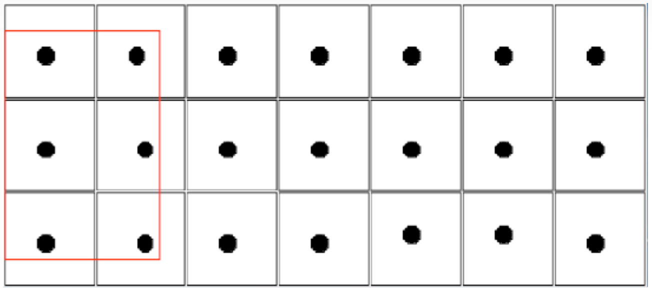
Disintegrating Textures

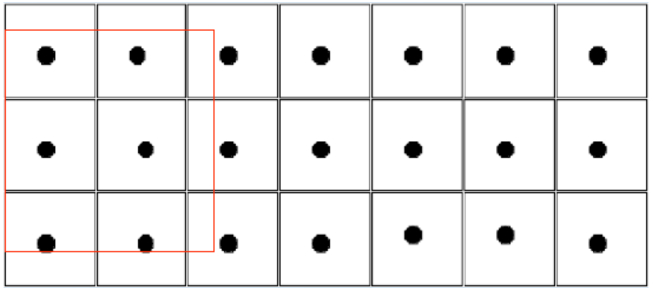
Stairs

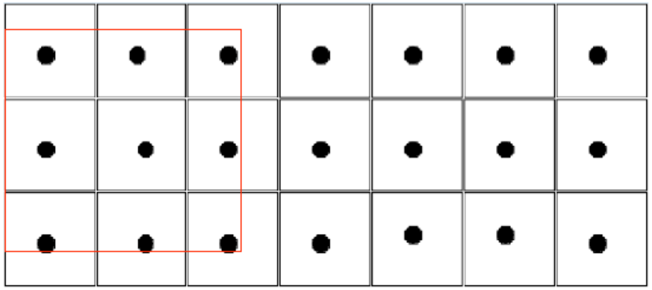


Small Objects

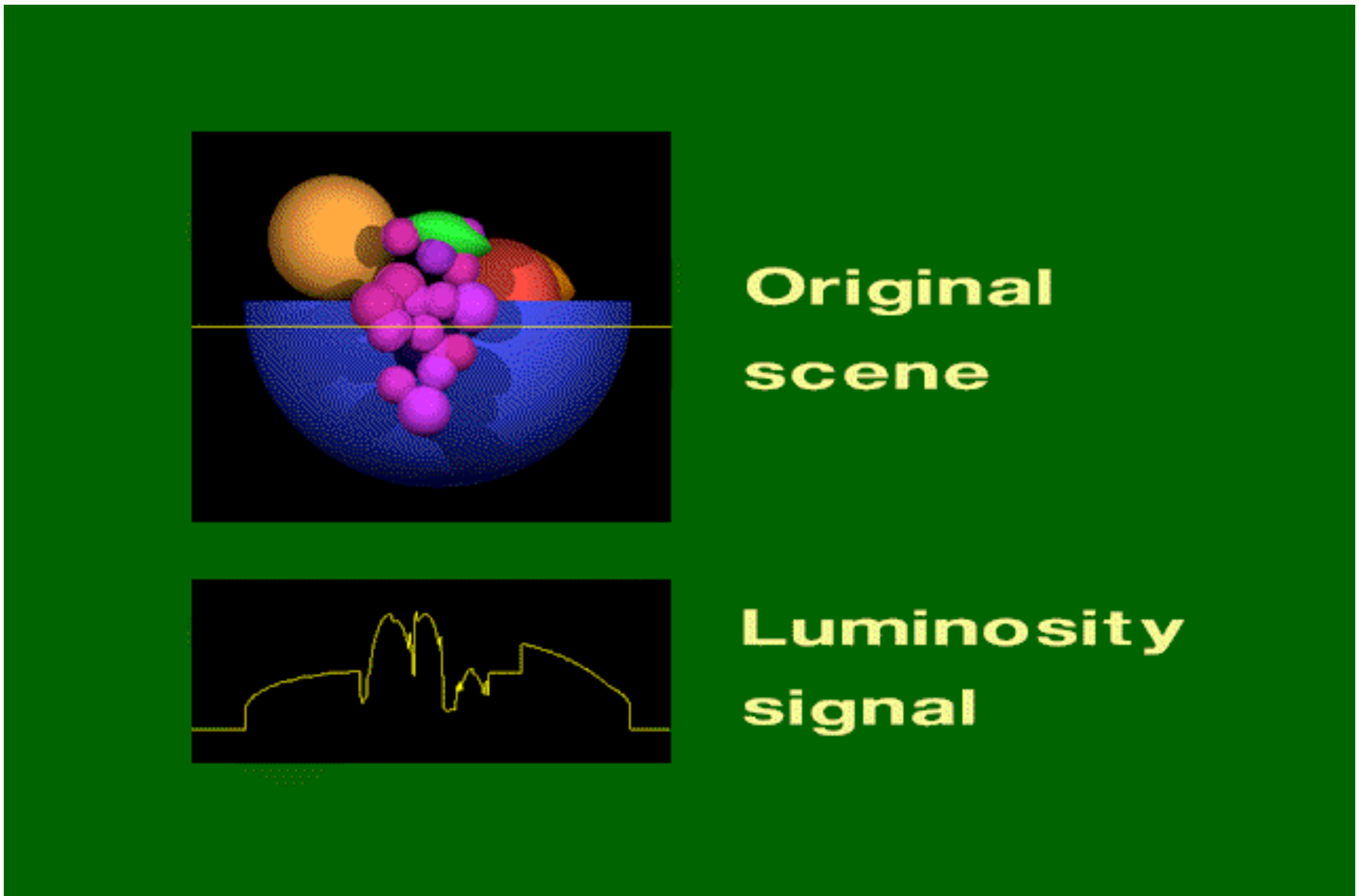








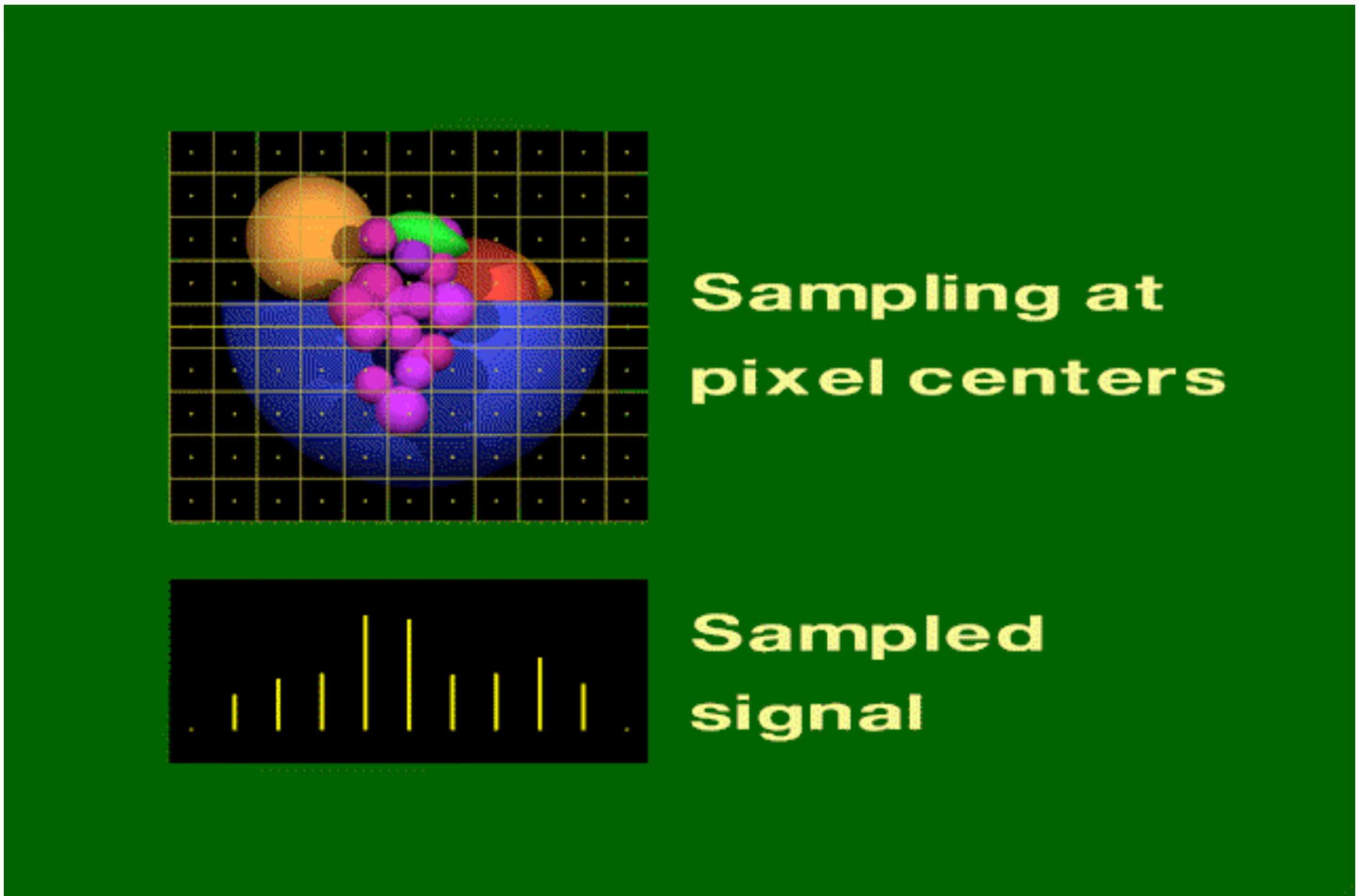
Original Scene



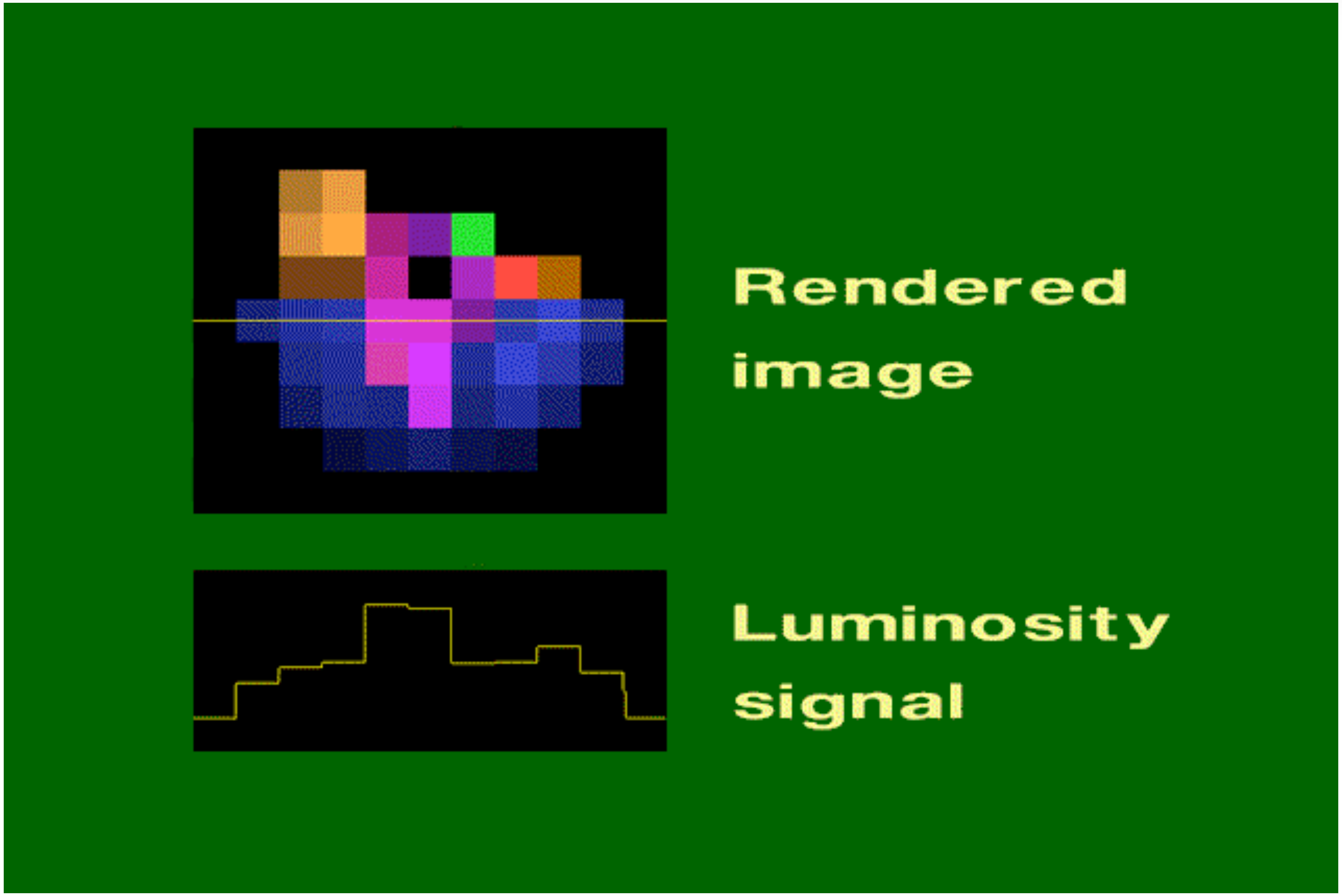
Rendering Process

- Two basic stages
  - Sampling
  - Reconstruction
- Assuming discrete sampling

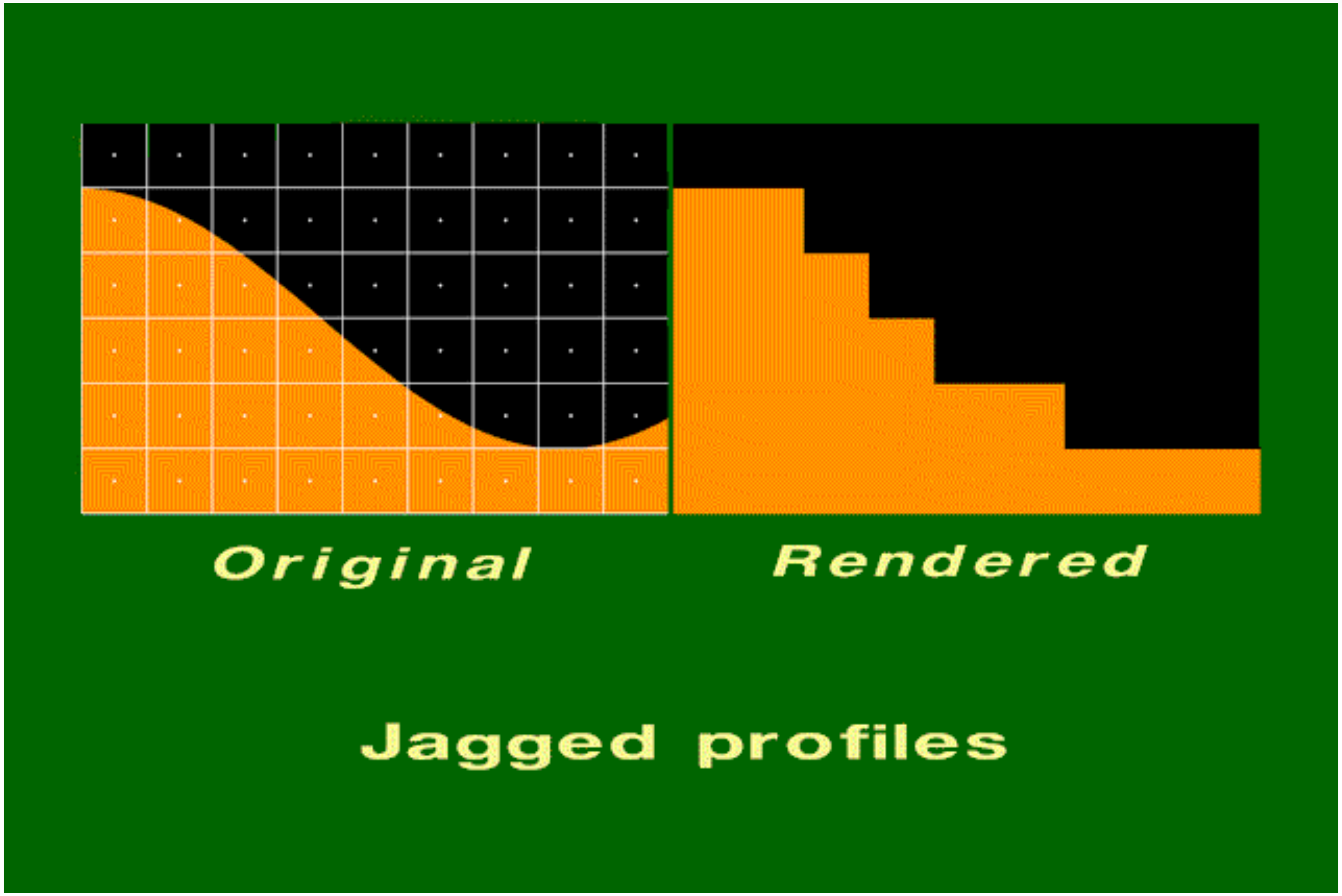
Sampling the Scene



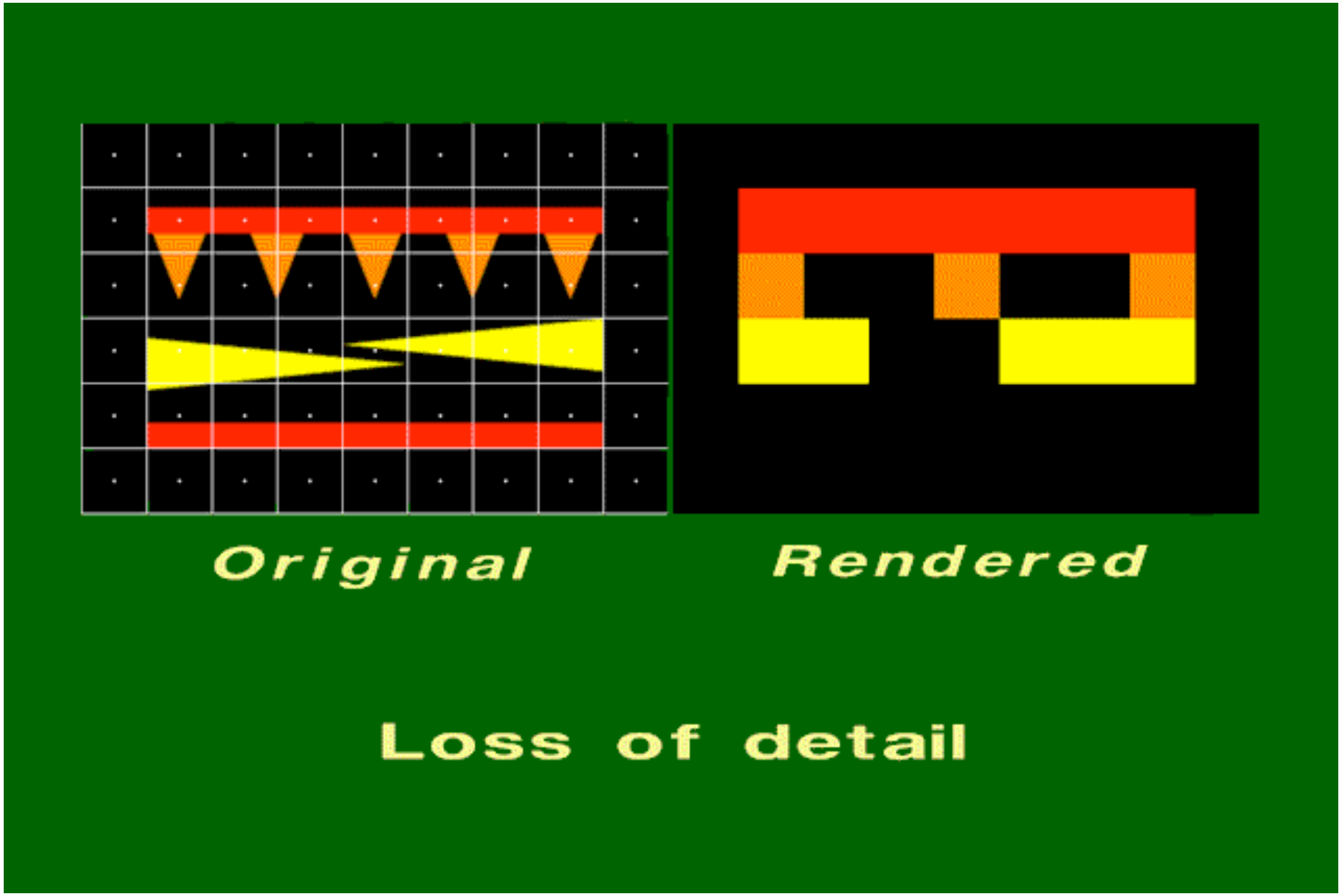
Rendered Image



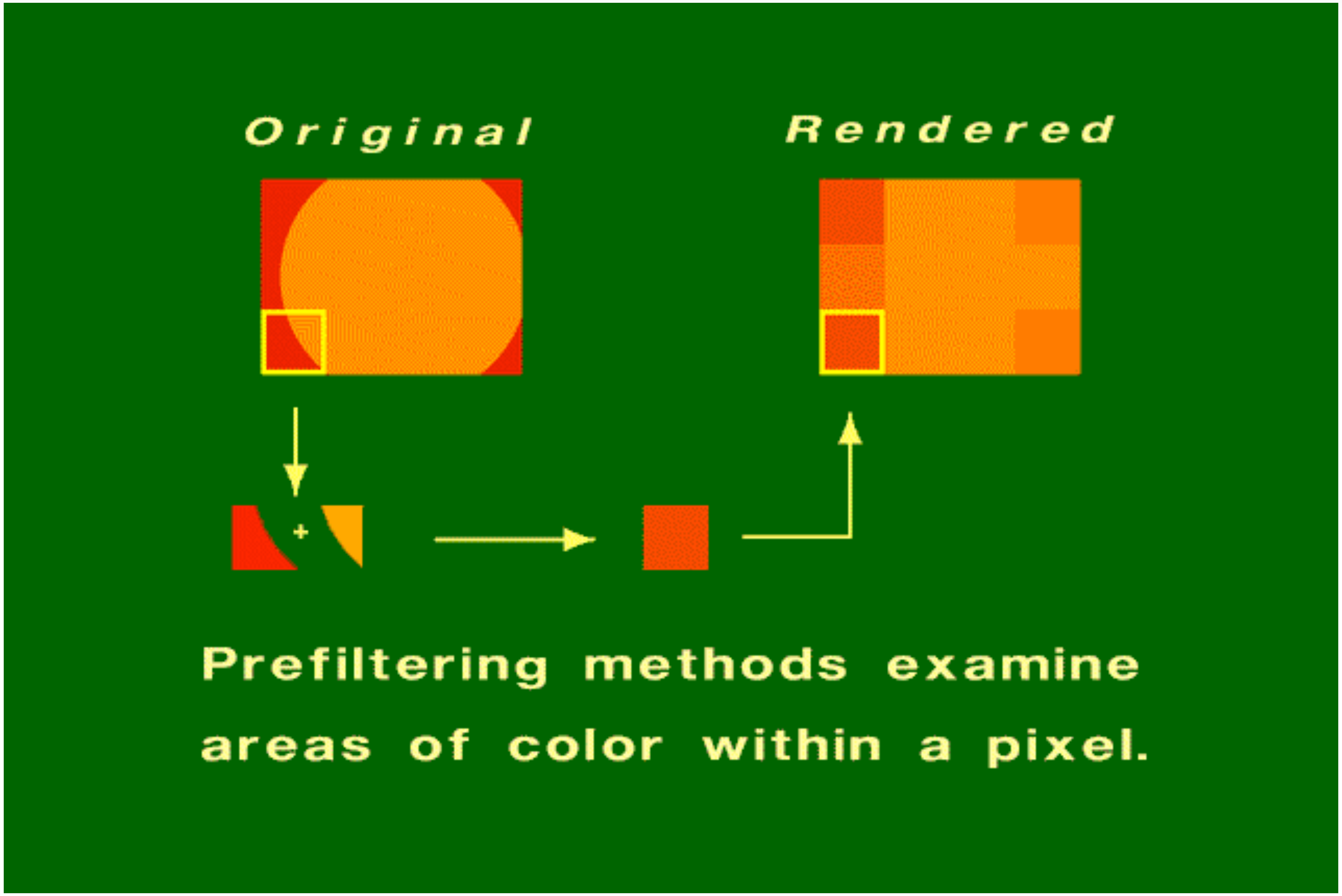
Jagged Profiles



Improperly Rendered Detail



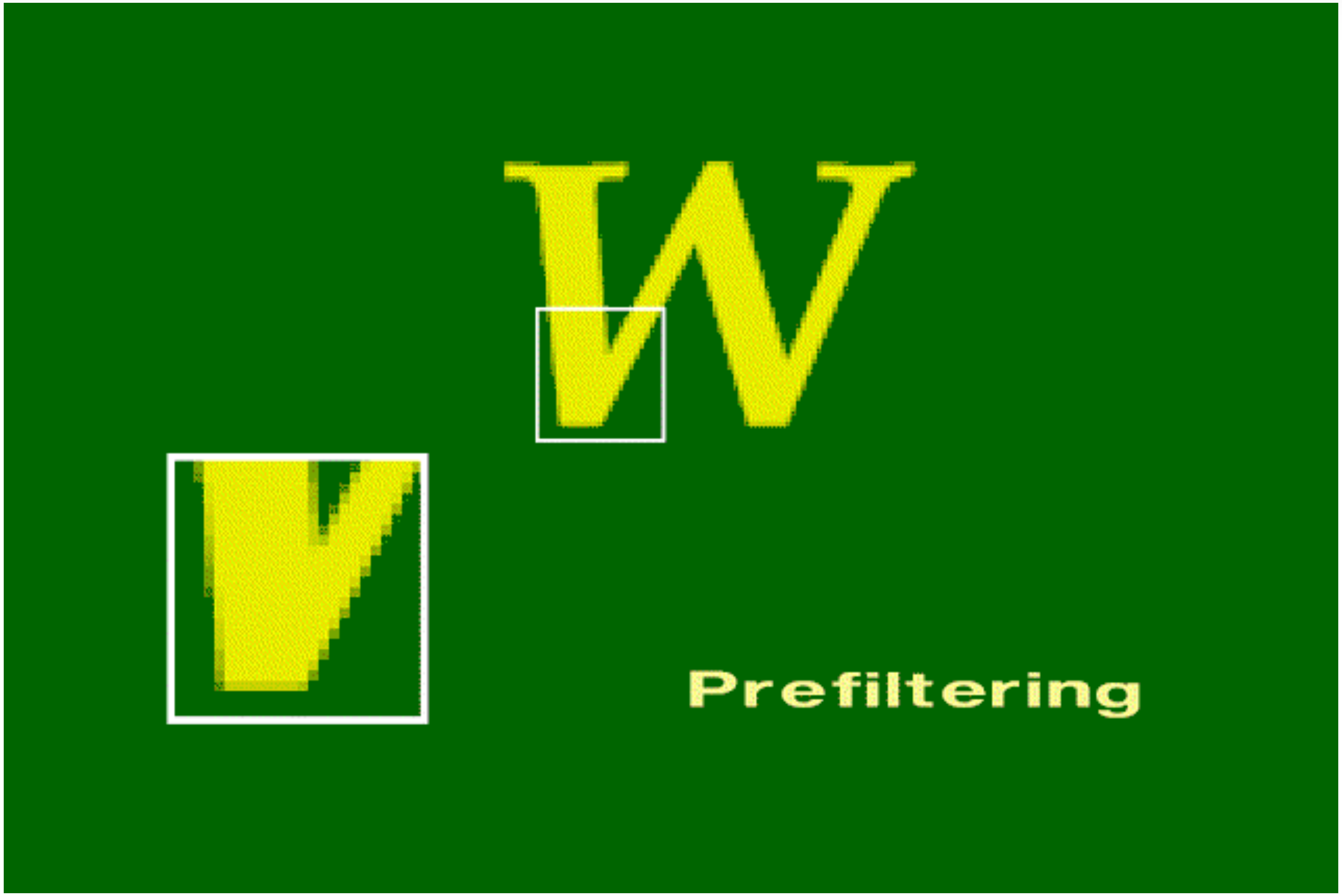
Basis for Prefiltering Algorithms



Prefiltering Demonstration

Closeup

Closeup of Prefiltered Image

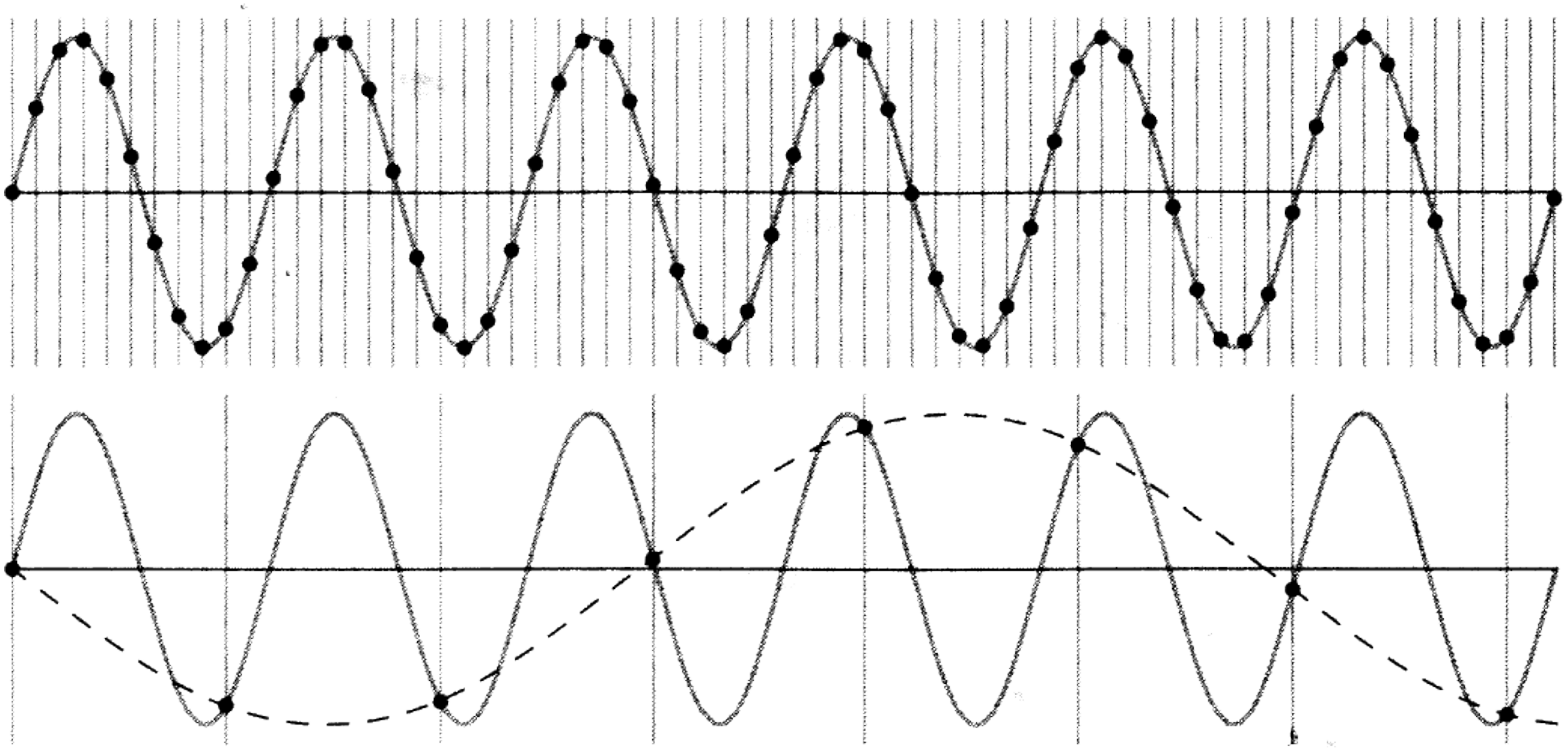


Sampling Theory

- 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 Issues

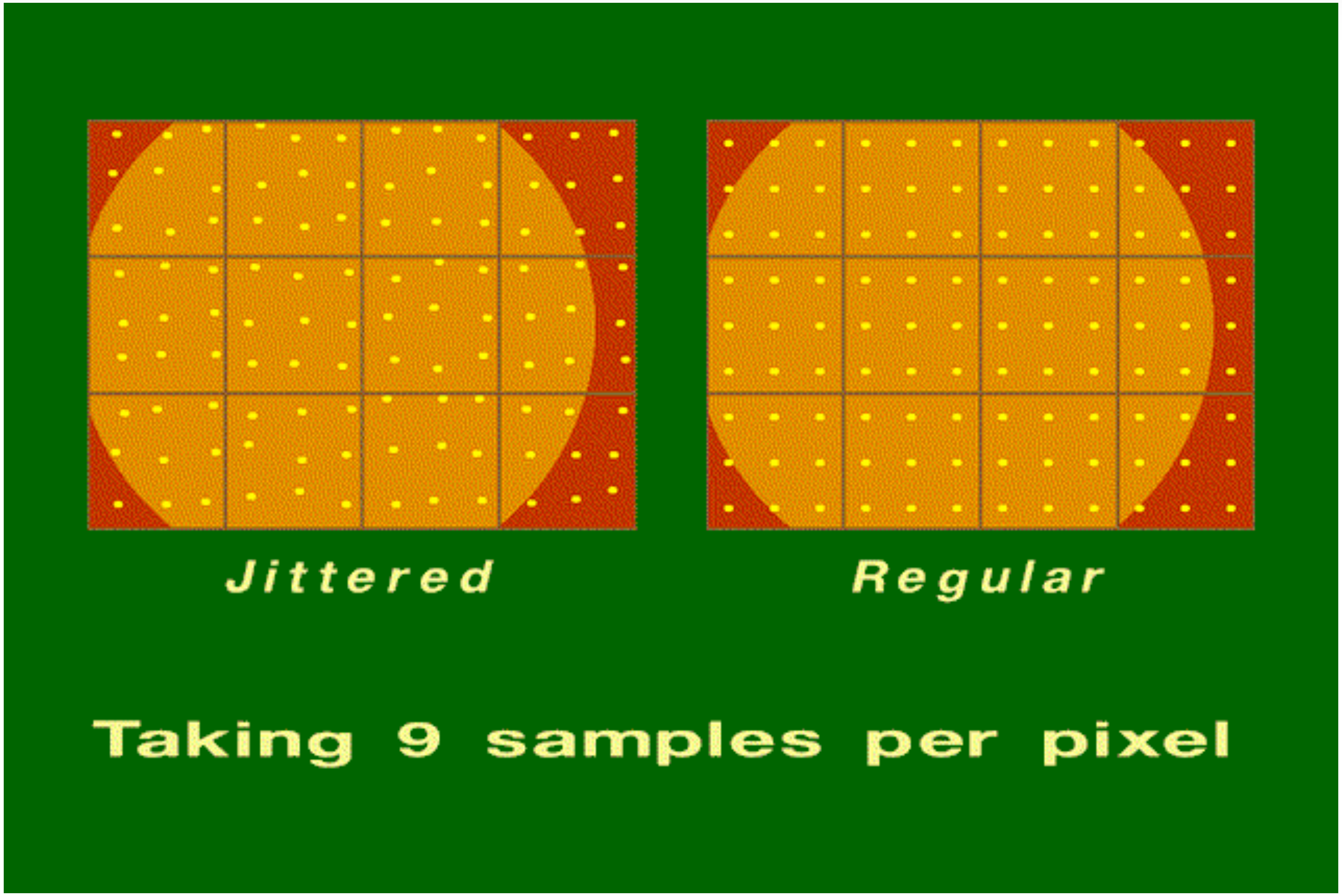
- Two samples of the same sine wave



Sampling Schemes

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

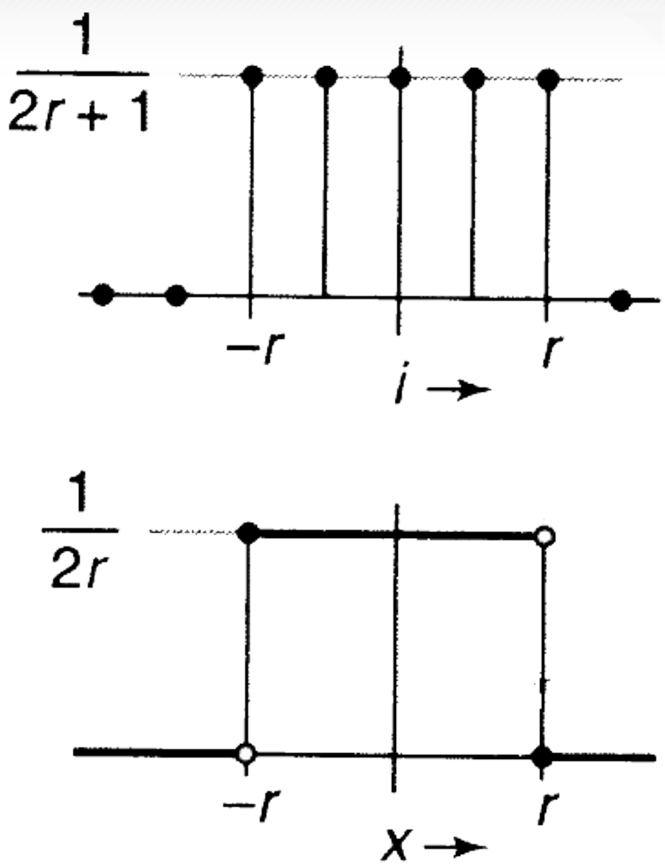
Sampling in the Postfiltering Method

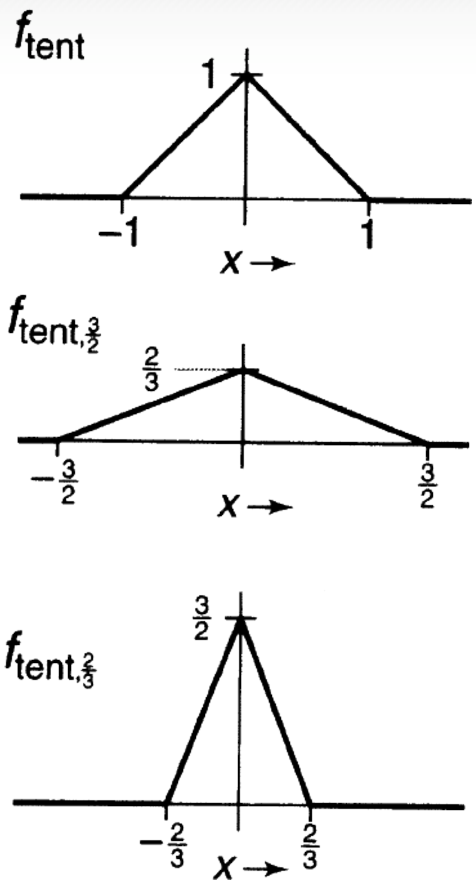


Reconstruction

- 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

Convolution Filters

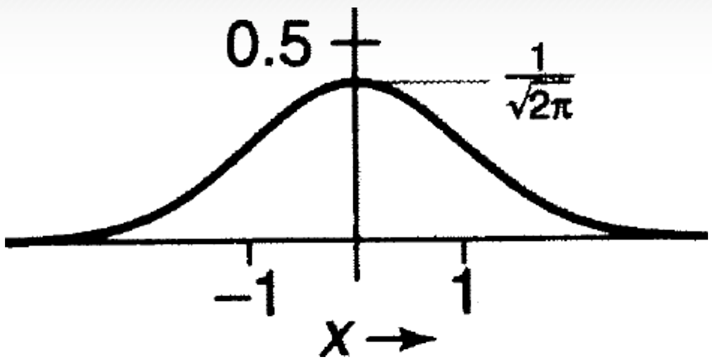




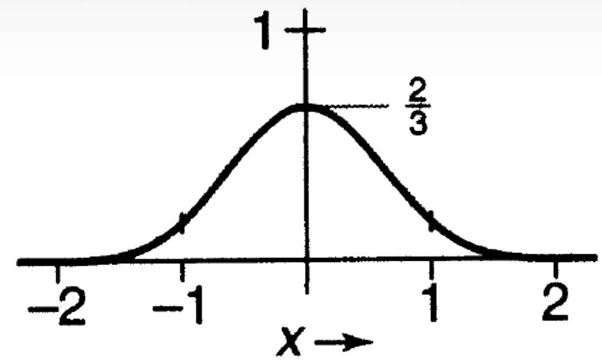
Box Filter

Tent Filter

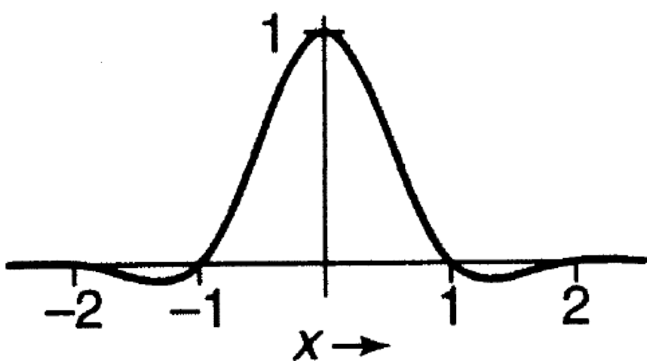
Convolution Filters



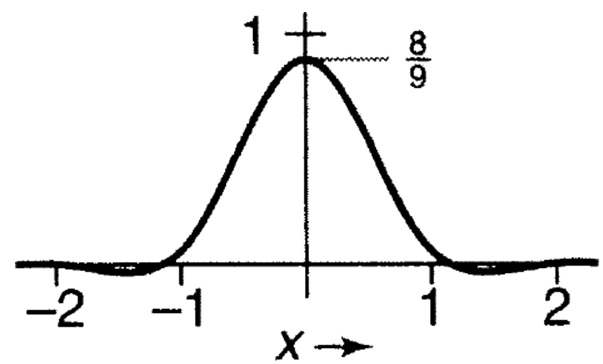
Gaussian Filter



B-Spline Filter

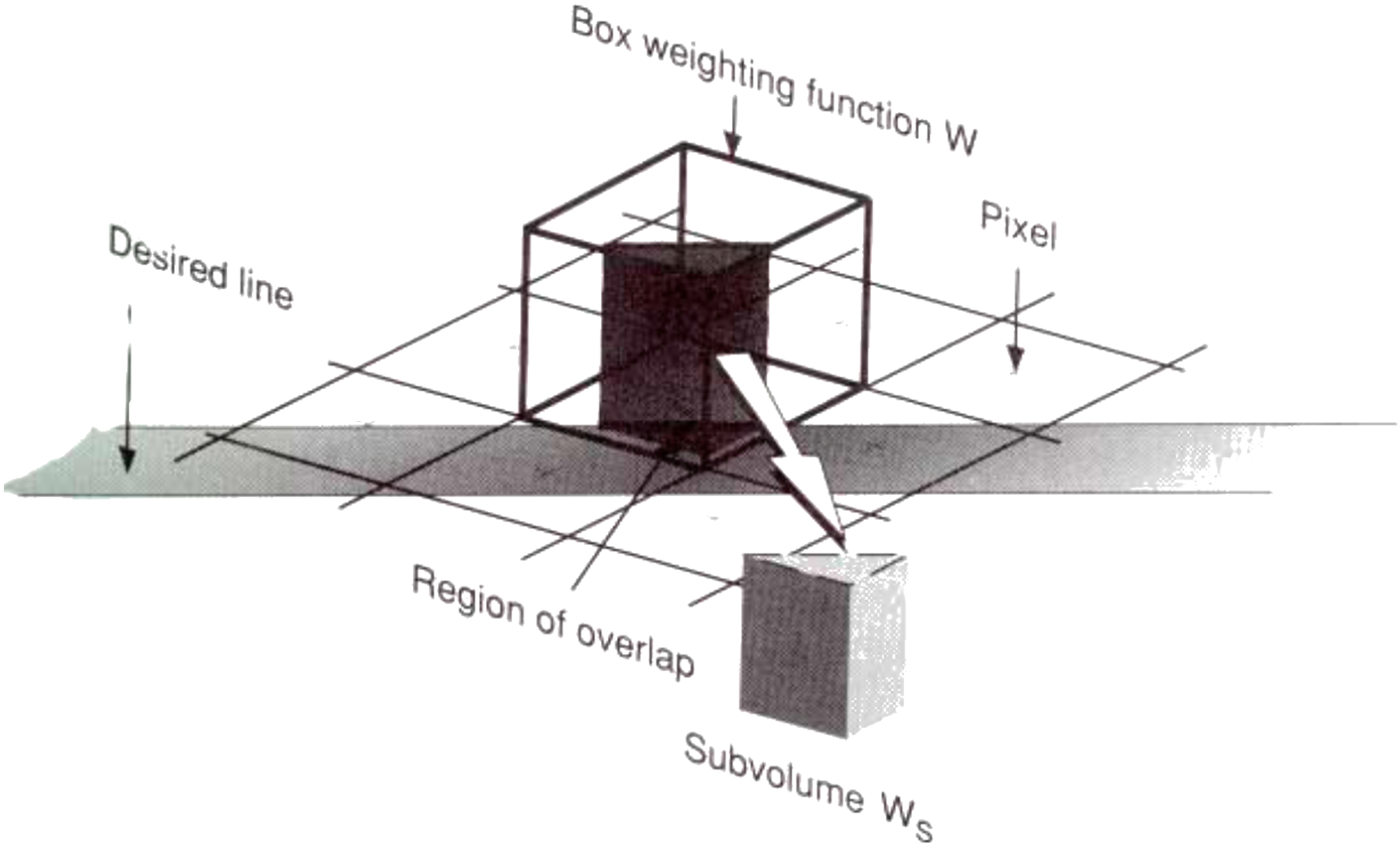


Catmull-Rom Filter

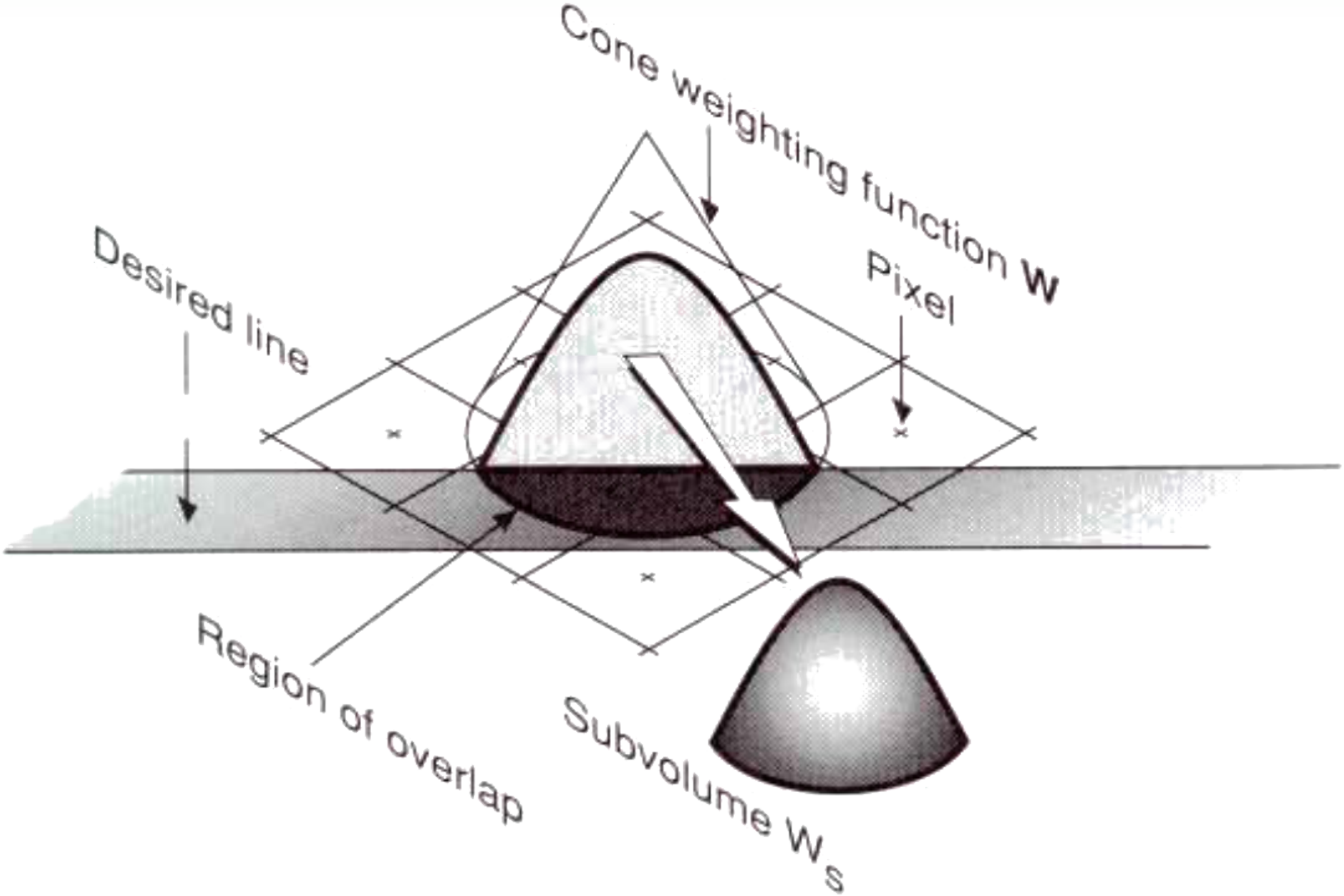


Mitchell-Netravali Filter

Box Weighting Function



Cone Weighting Function



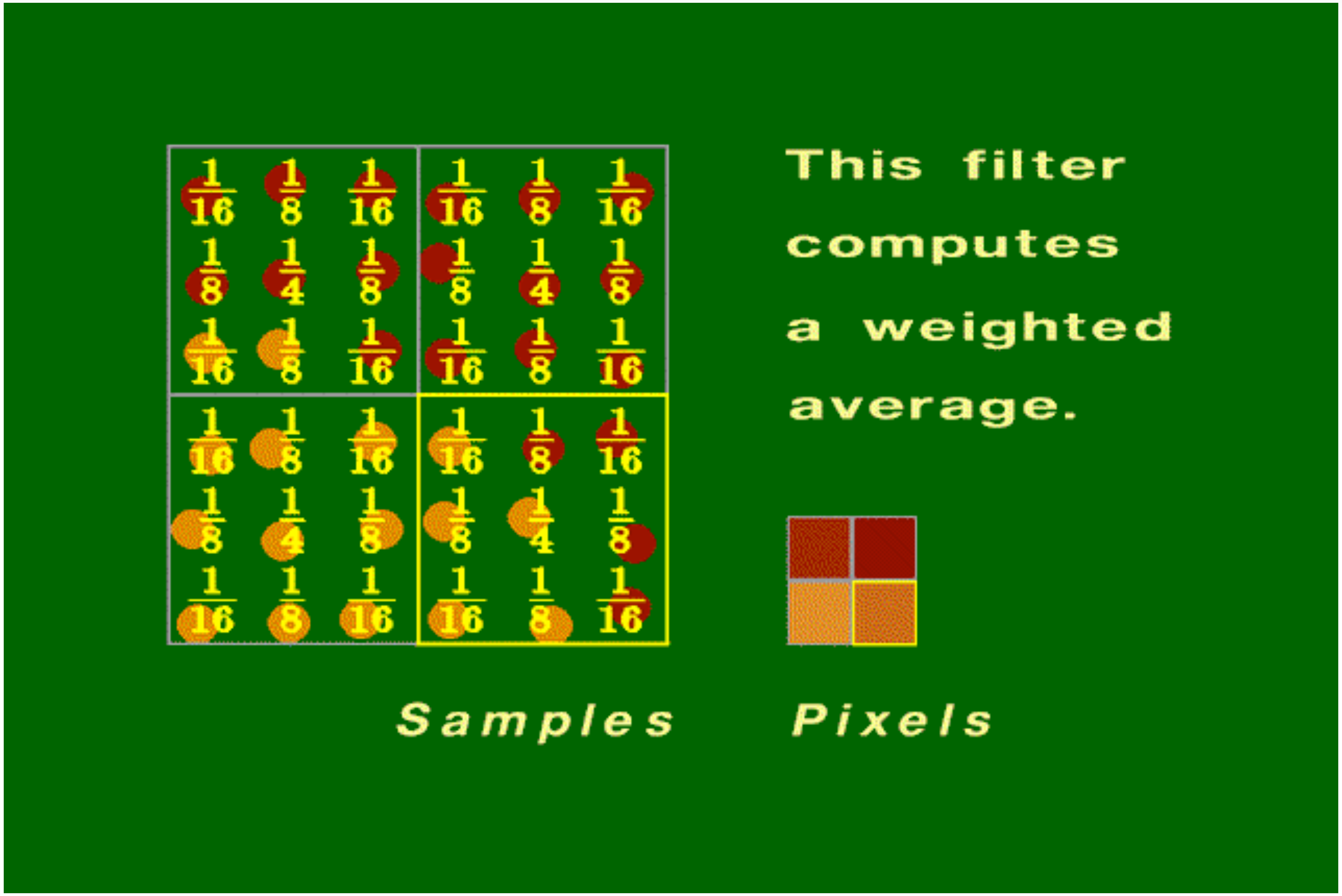
Filters

$\frac{1}{16}$	$\frac{1}{8}$	$\frac{1}{16}$
$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{8}$
$\frac{1}{16}$	$\frac{1}{8}$	$\frac{1}{16}$

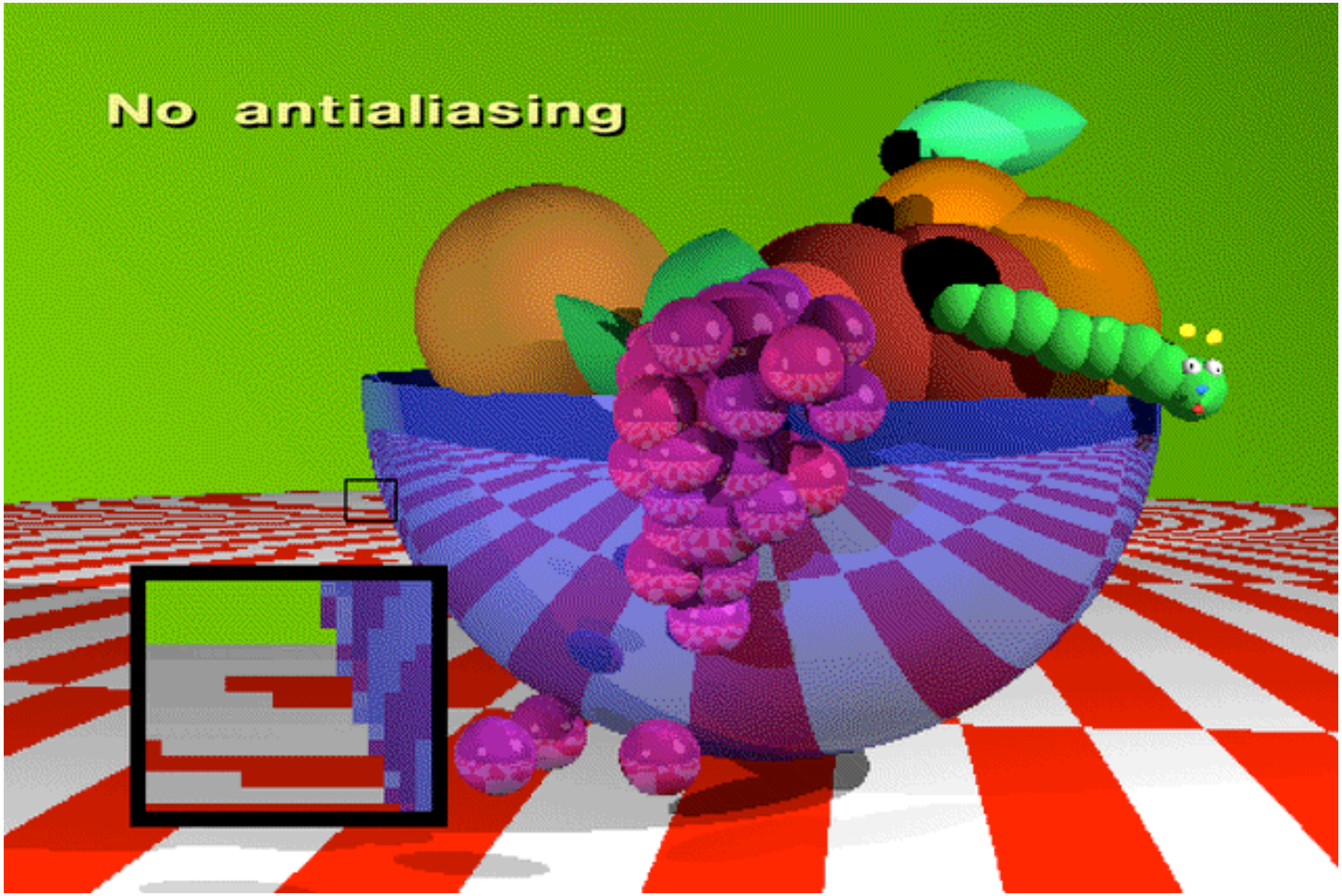
Combines nine samples

Filters combine samples to find a pixel's color.

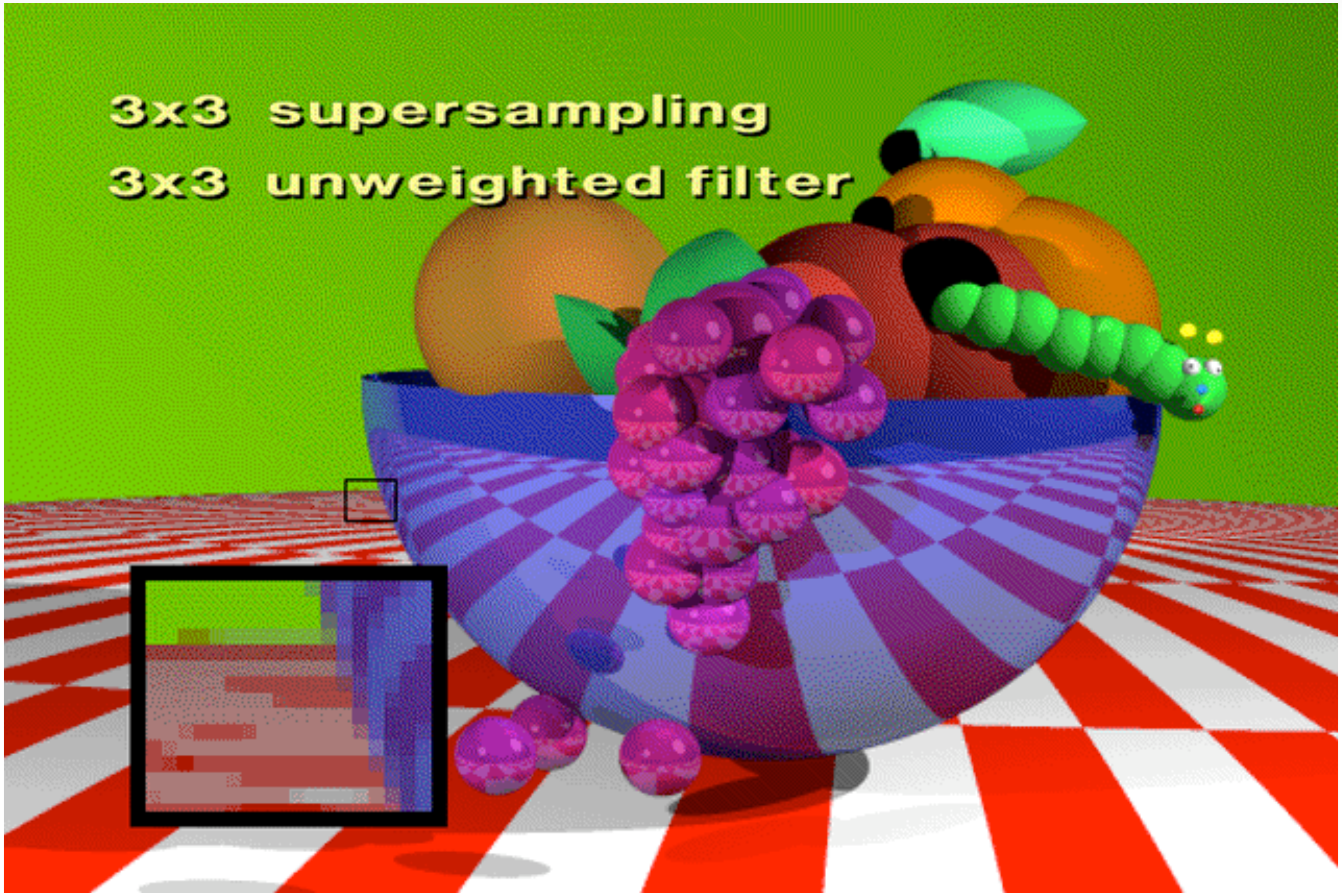
Using a Filter to Compute Pixel Color



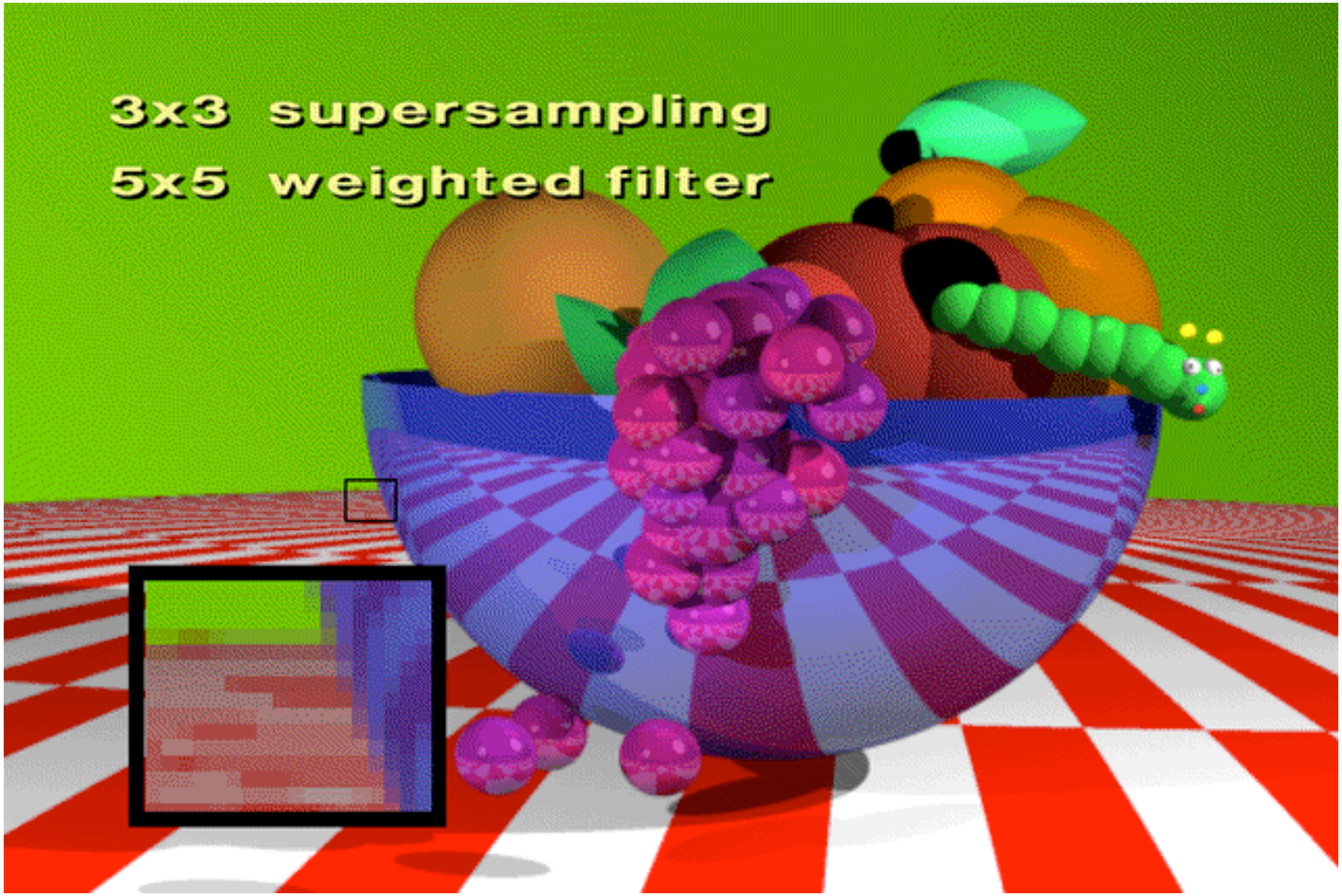
No Antialiasing



With Antialiasing



With Antialiasing



With Antialiasing