Computer Graphics (CS 4731)
Image Processing

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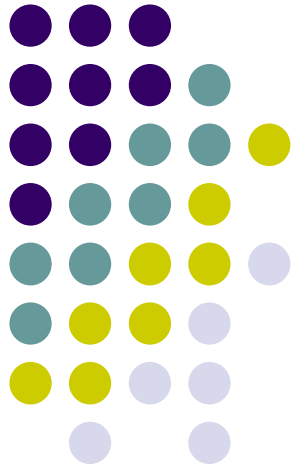
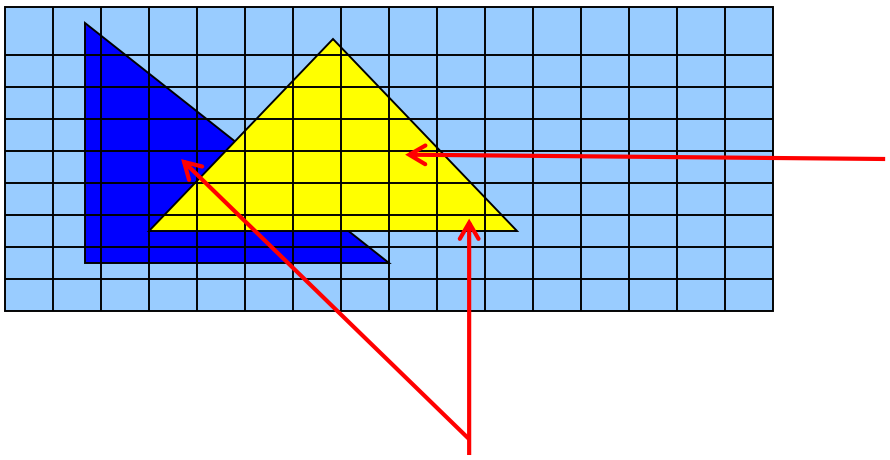


Some Slides Courtesy of Emmanuel Agu (WPI)

Rasterization

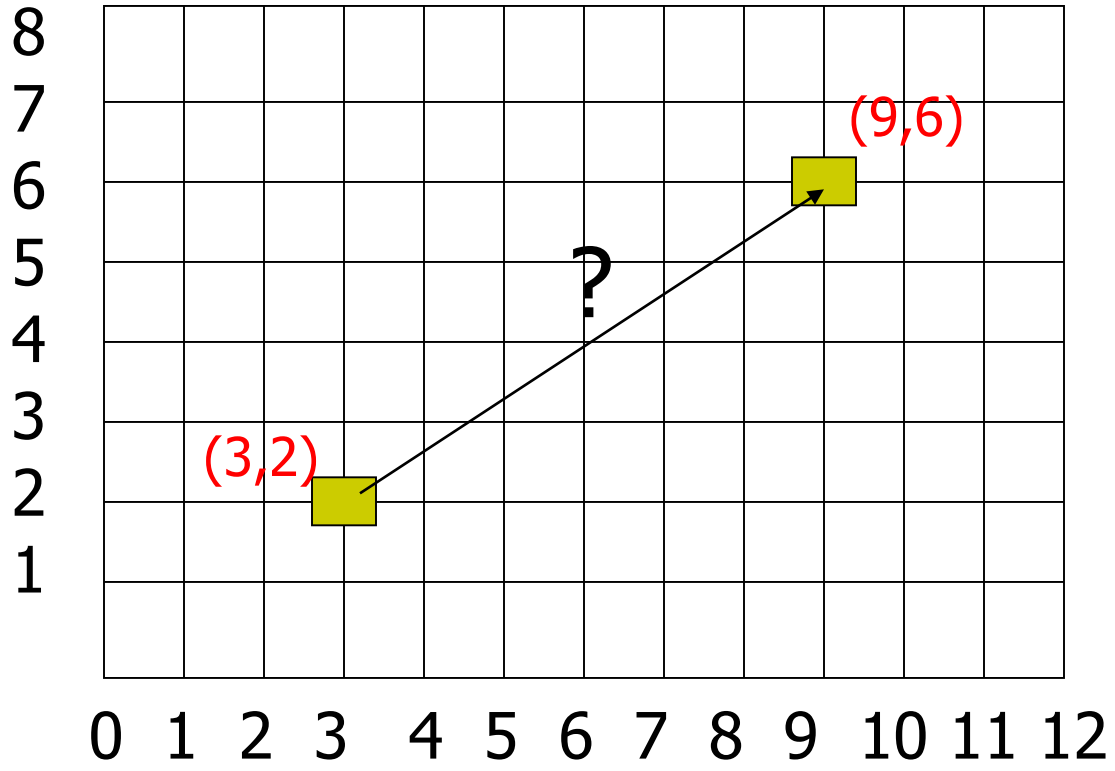
- Rasterization generates set of **fragments**
- Implemented by graphics hardware
- Rasterization algorithms for primitives (e.g lines, circles, triangles, polygons)



Rasterization: Determine Pixels (fragments) each primitive covers

Line drawing algorithm

- Programmer specifies (x,y) of end pixels
- Need algorithm to determine pixels on line path

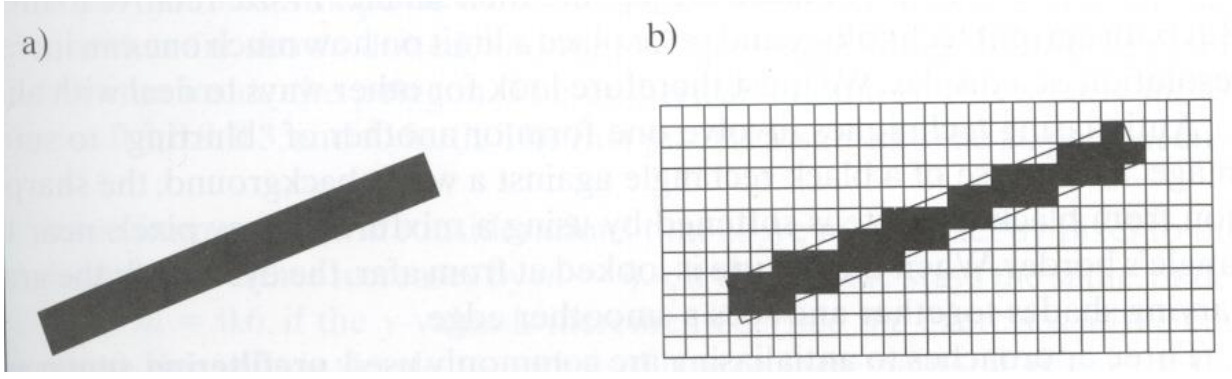


Line: (3,2) -> (9,6)

Which intermediate pixels to turn on?

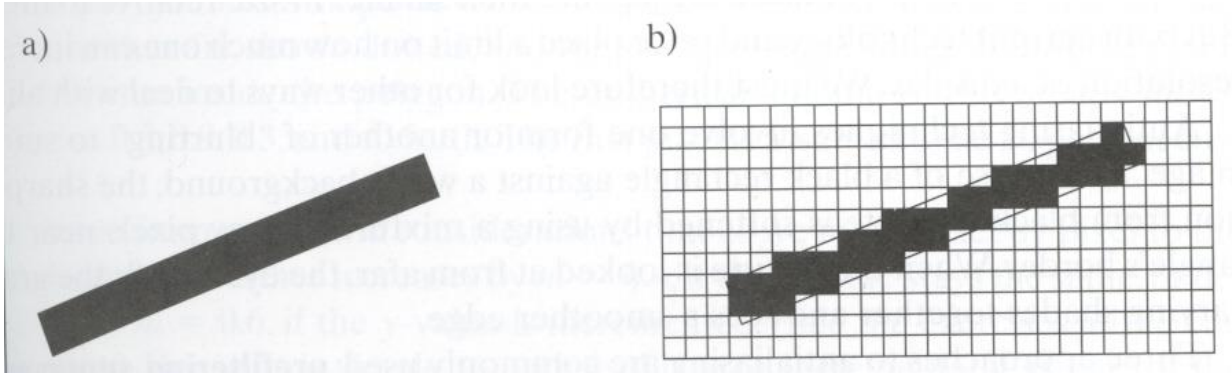
Line drawing algorithm

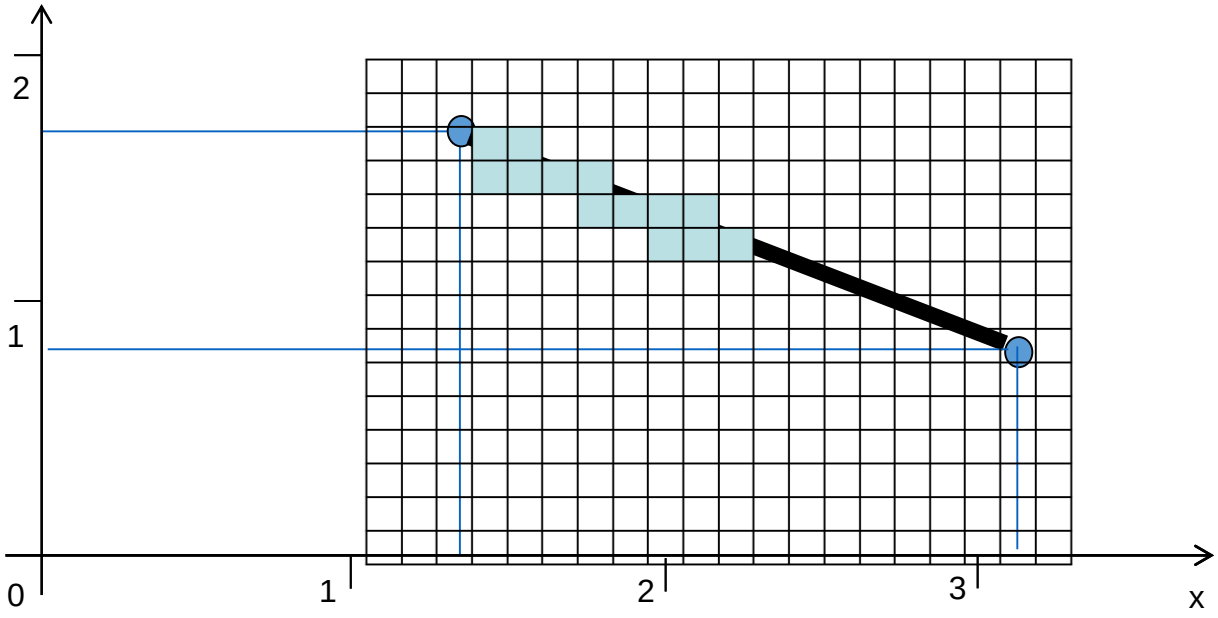
- Pixel (x,y) values constrained to integer values
- Computed intermediate values may be floats
- Rounding may be required. E.g. (10.48, 20.51) rounded to (10, 21)
- Rounded pixel value is off actual line path (jaggy!!)
- Sloped lines end up having jaggies
- Vertical, horizontal lines, no jaggies

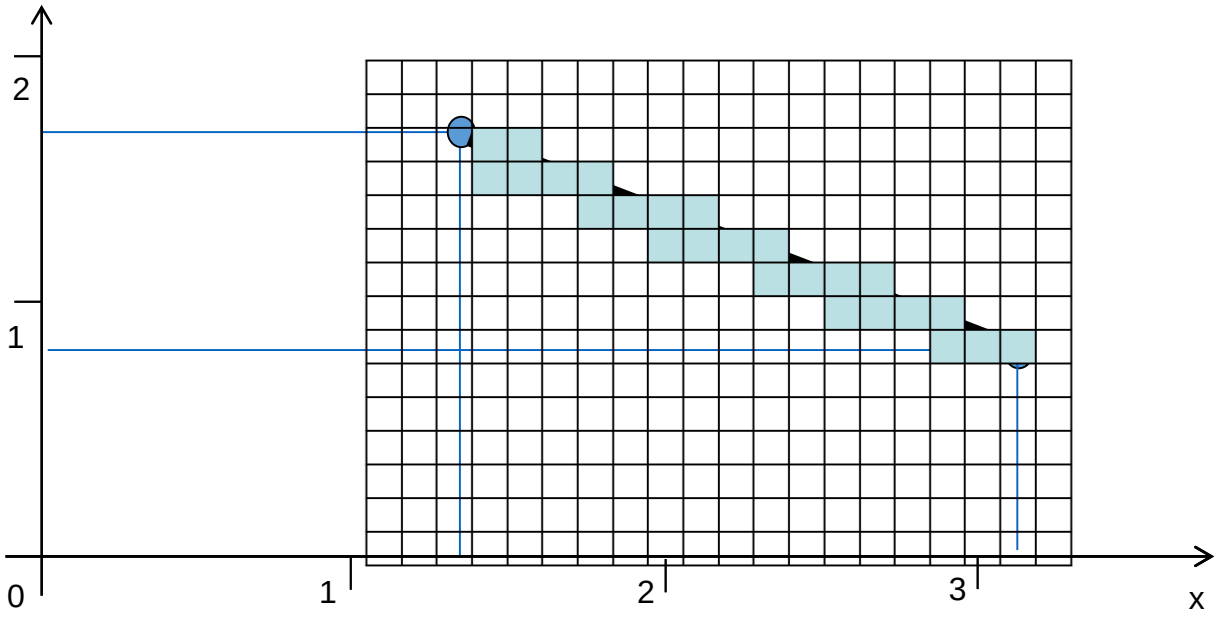


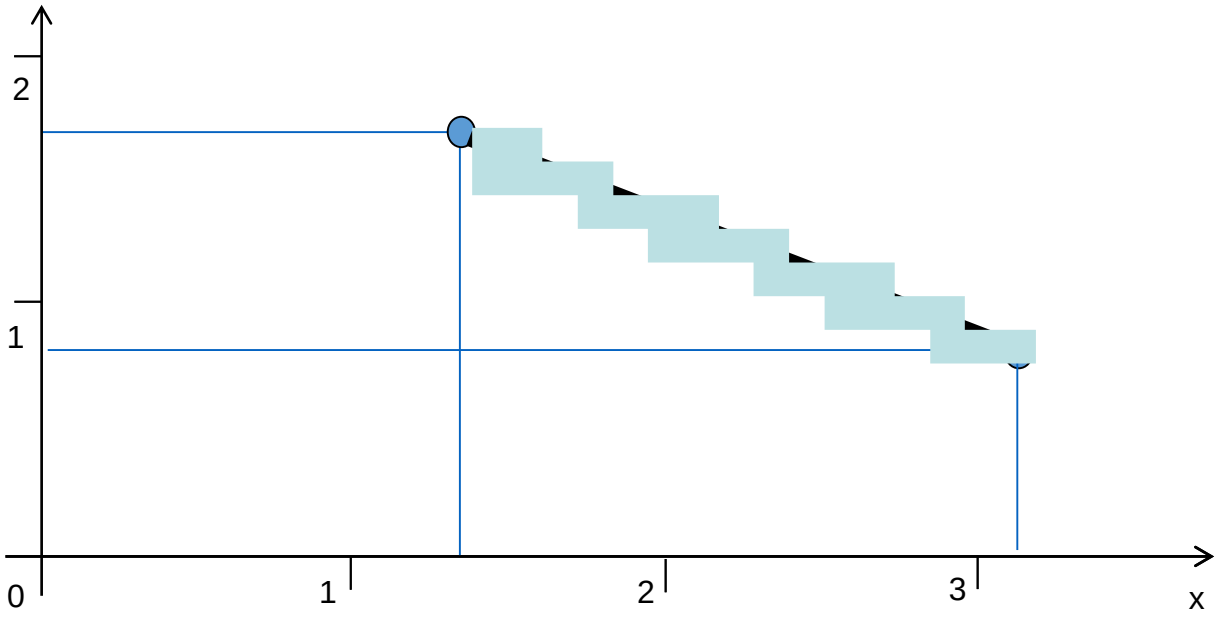
Antialiasing

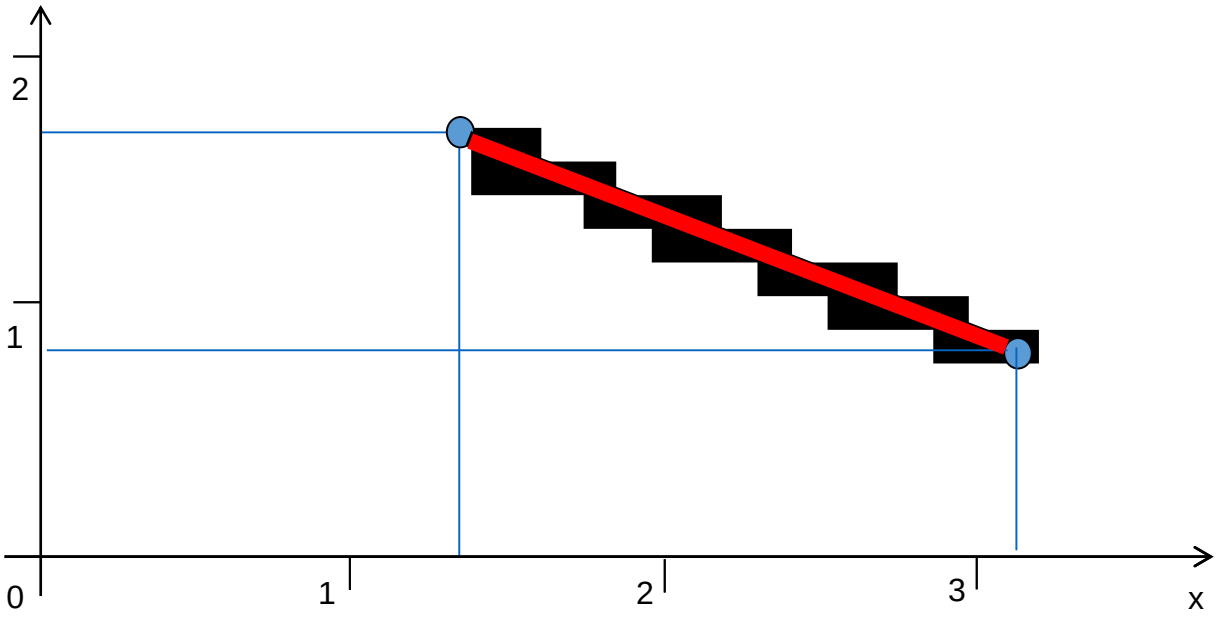
- Raster displays have pixels as rectangles
- Aliasing: Discrete nature of pixels introduces "jaggies"

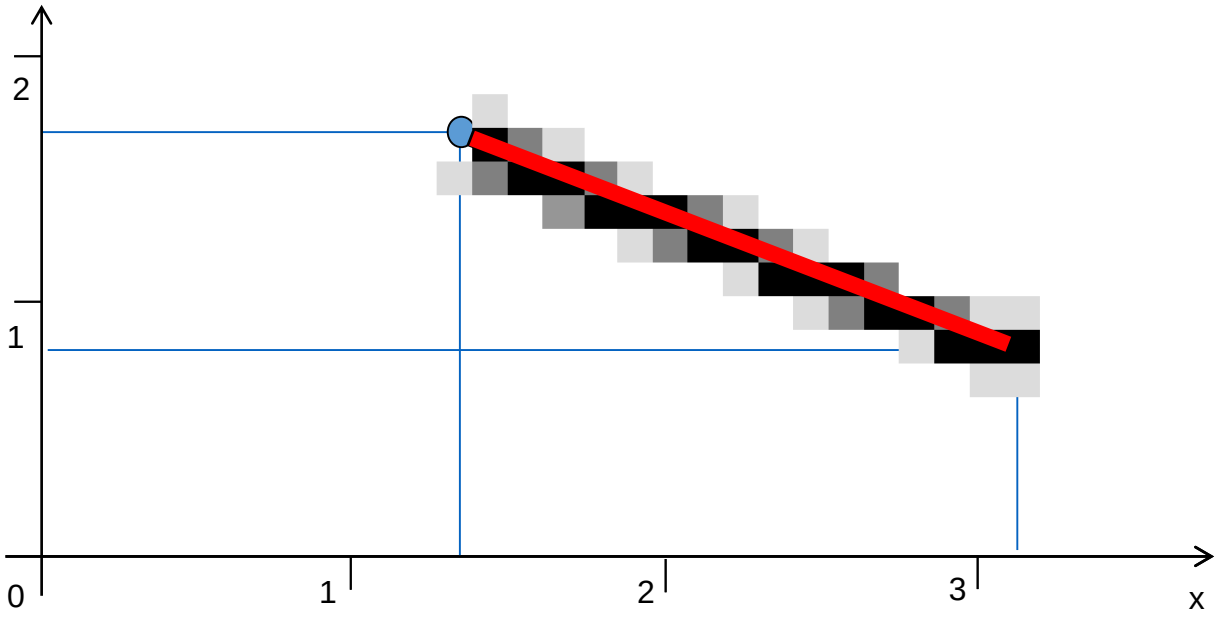



2
1
0
1
2
3
x

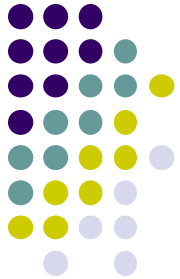

2
1
0
1
2
3
x


2
1
0
1
2
3
x


2
1
0
1
2
3
x


2
1
0
1
2
3
x

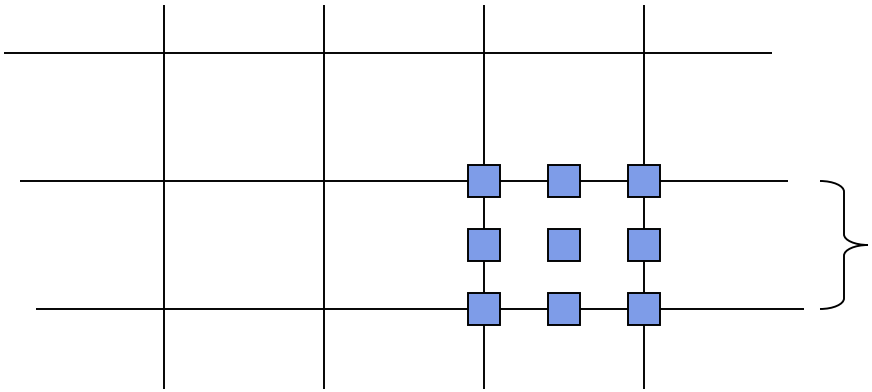
Prefiltering



- Basic idea:
  - compute area of polygon coverage
  - use proportional intensity value
- Example: if polygon covers ¼ of the pixel
  - Pixel color = ¼ polygon color + ¾ adjacent region color
- Cons: computing polygon coverage can be time consuming

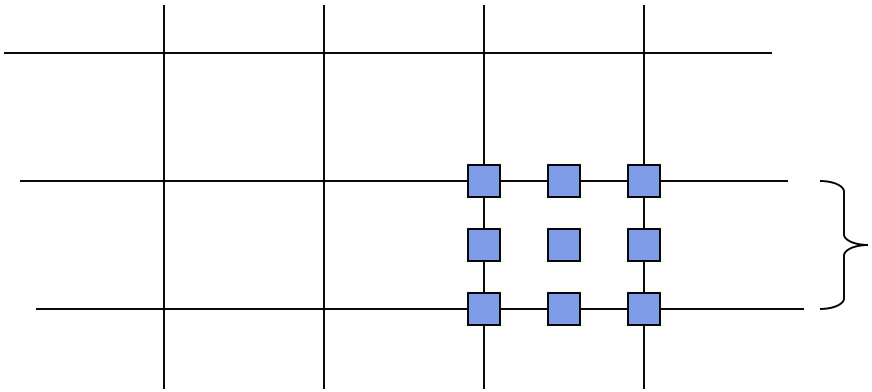
Supersampling

- Assumes we can compute color of any location (x,y) on screen
- Sample (x,y) in fractional (e.g. ½) increments, average samples
- Example: Double sampling = increments of ½ = 9 color values averaged for each pixel



Postfiltering

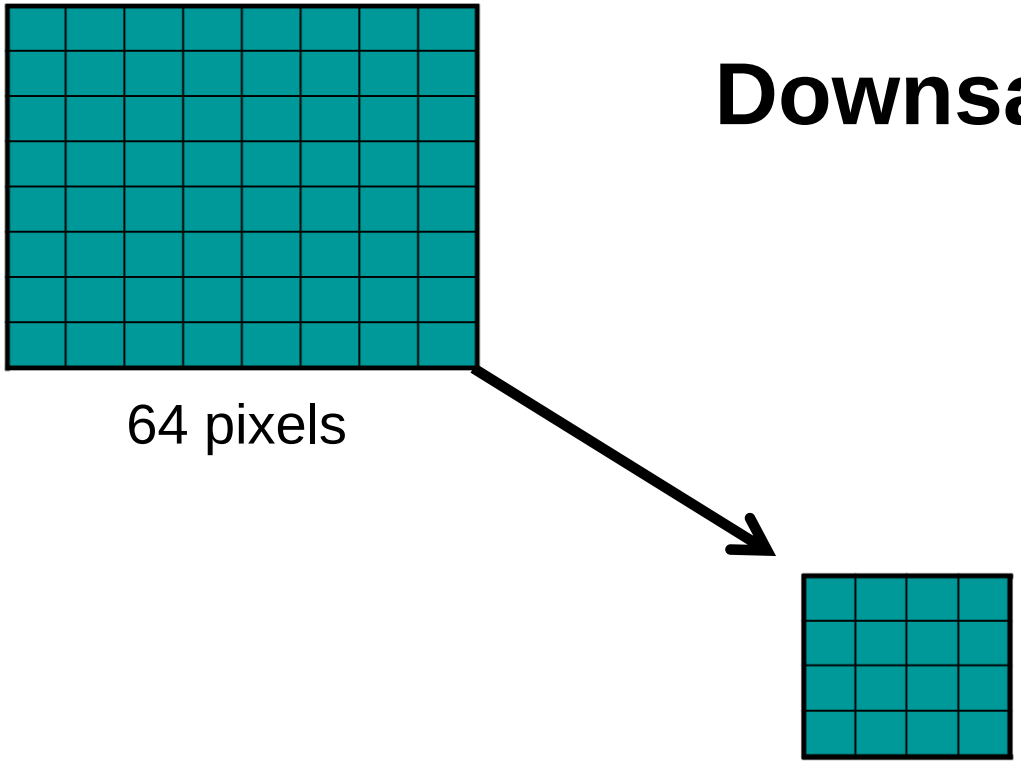
- Supersampling weights all samples equally
- Post-filtering: use unequal weighting of samples
- Compute pixel value as weighted average
- Samples close to pixel center given more weight



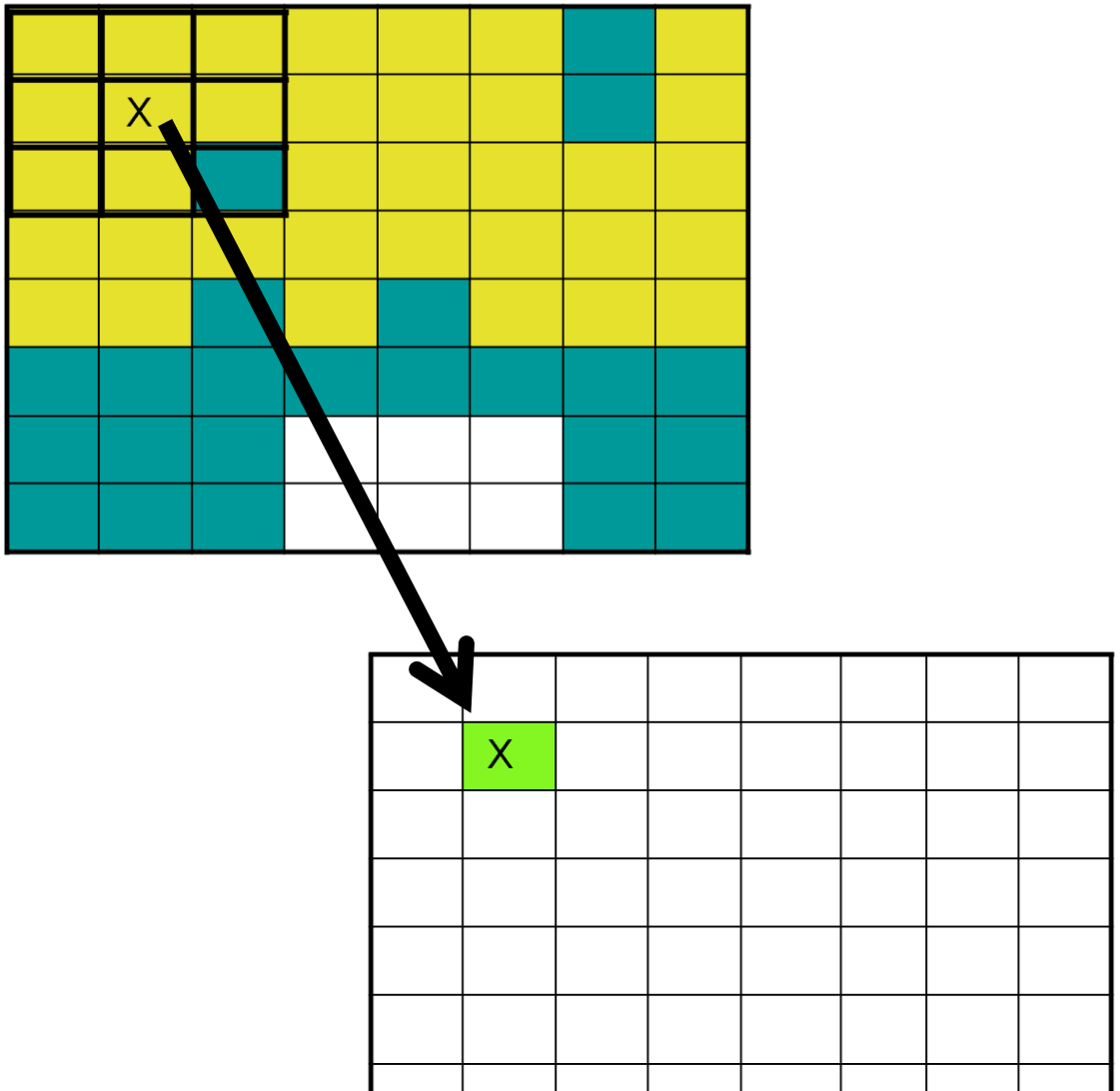
Sample weighting

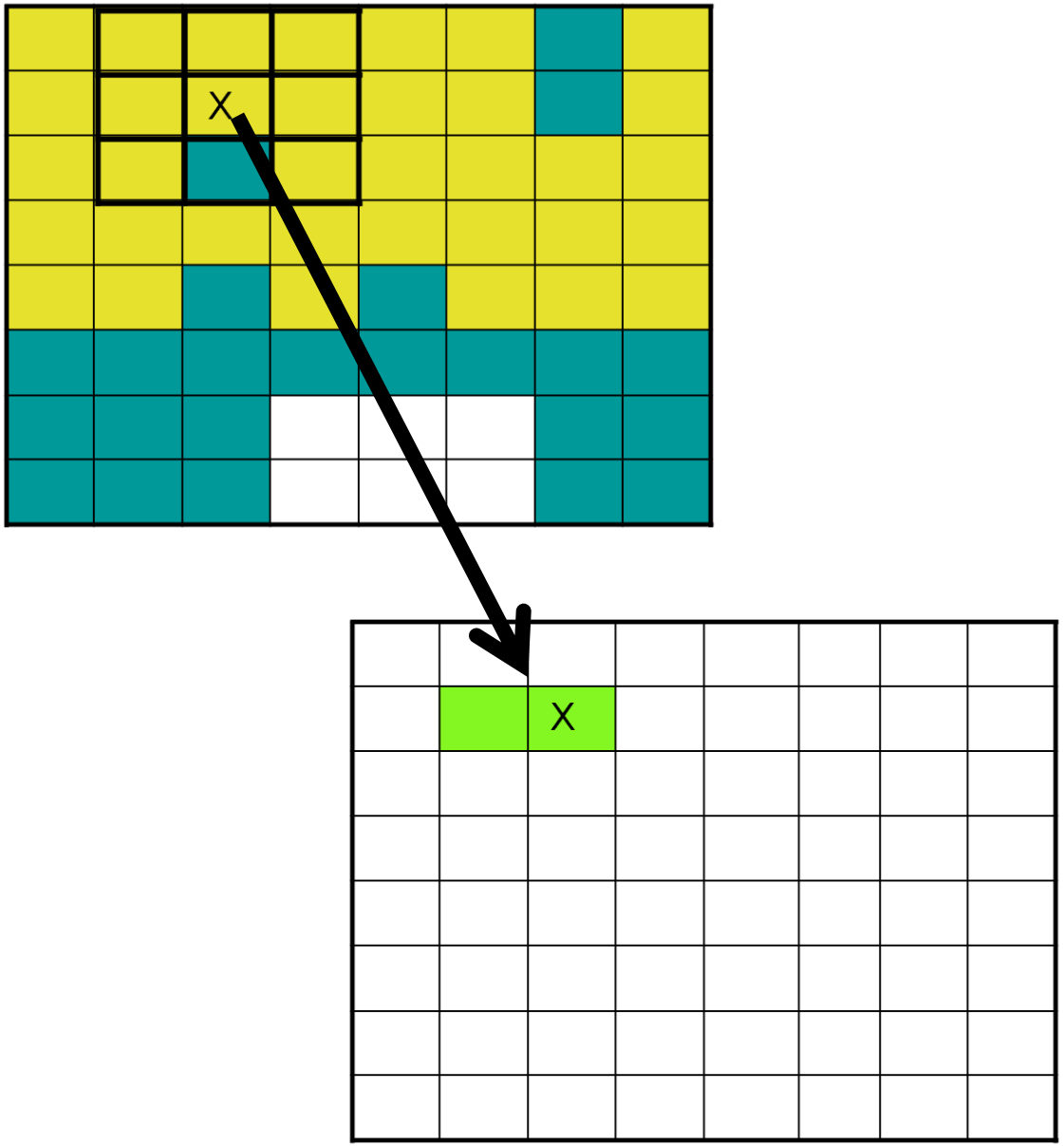
1/16	1/16	1/16
1/16	1/2	1/16
1/16	1/16	1/16

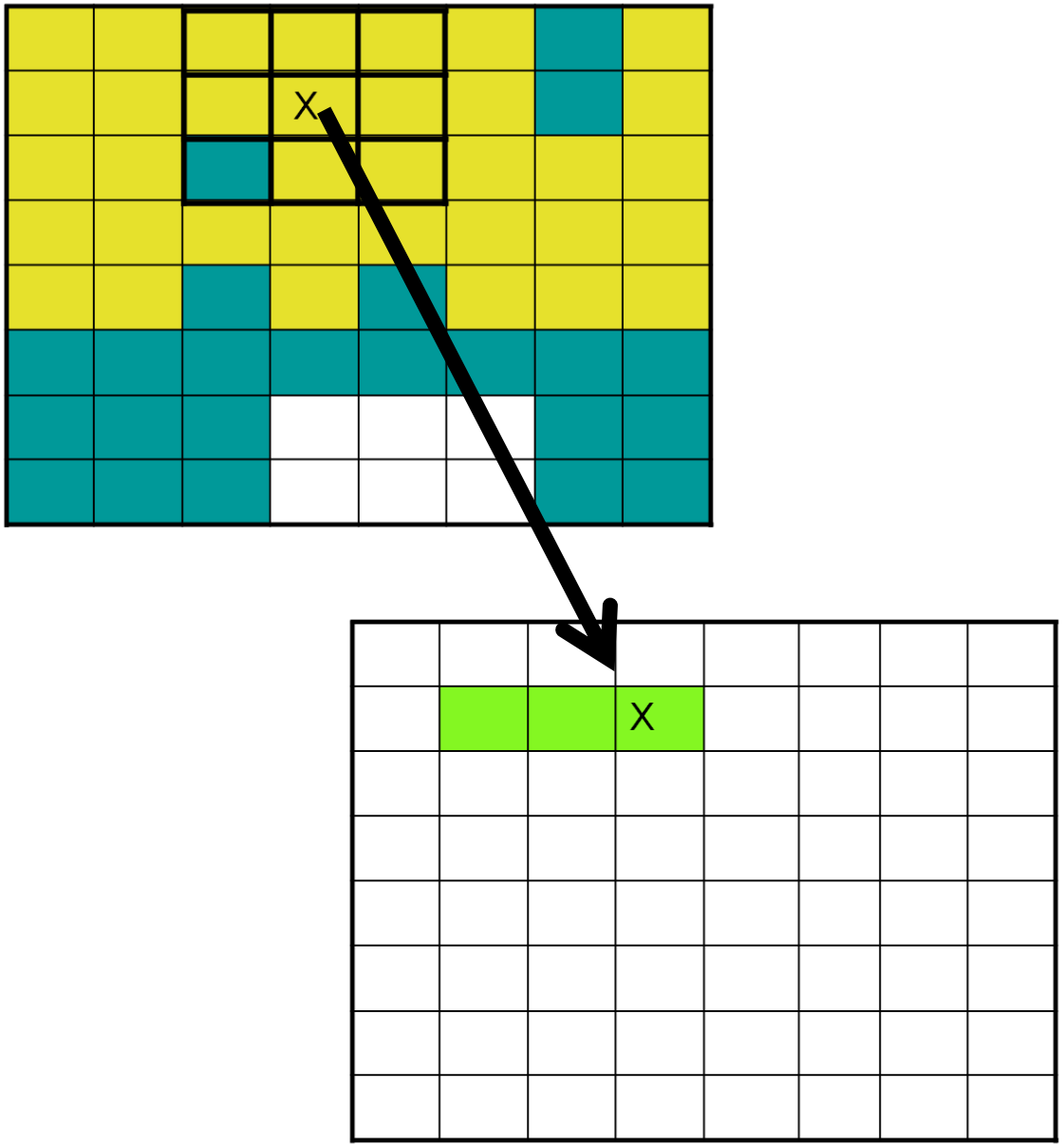
Downsampling

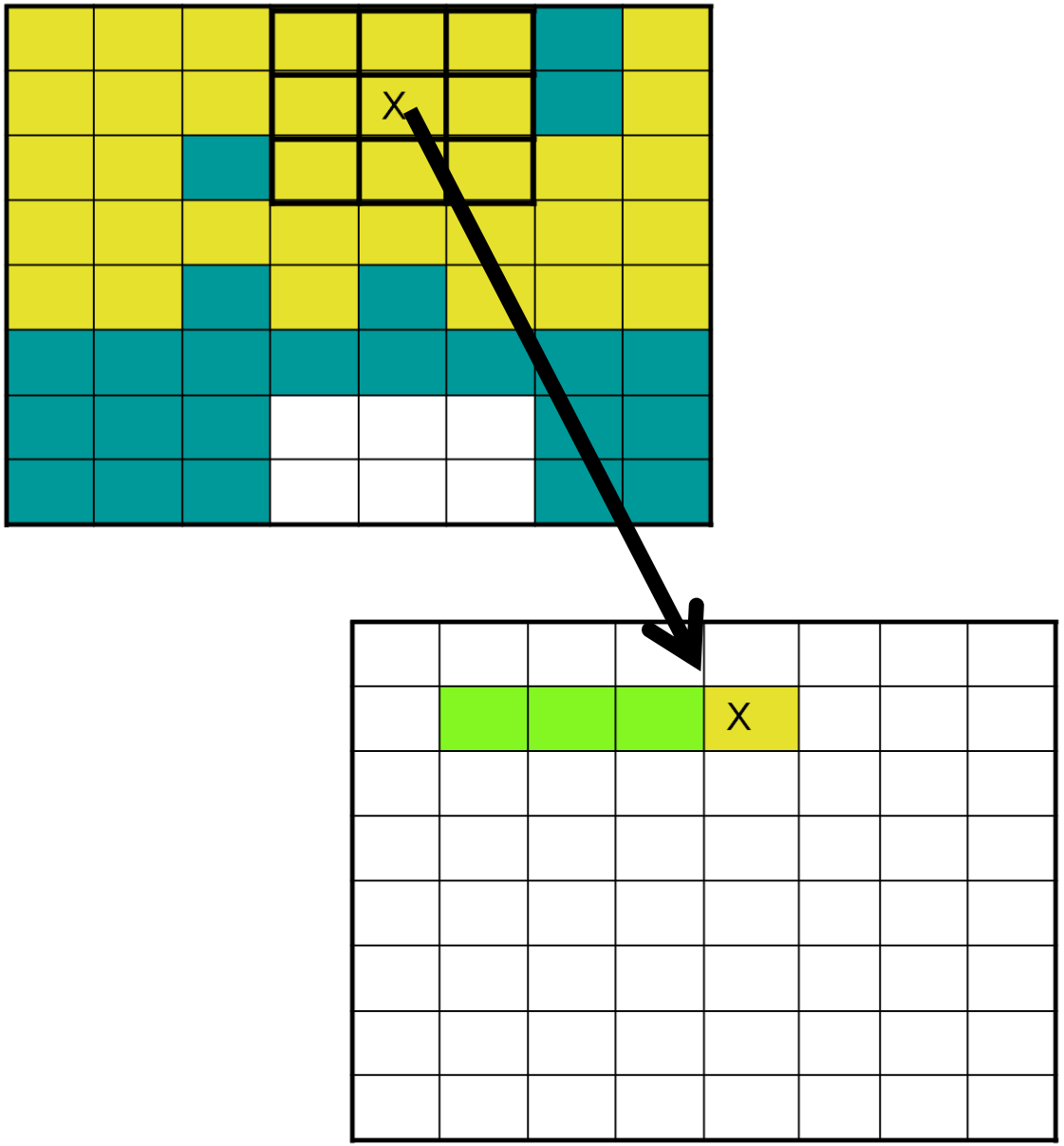


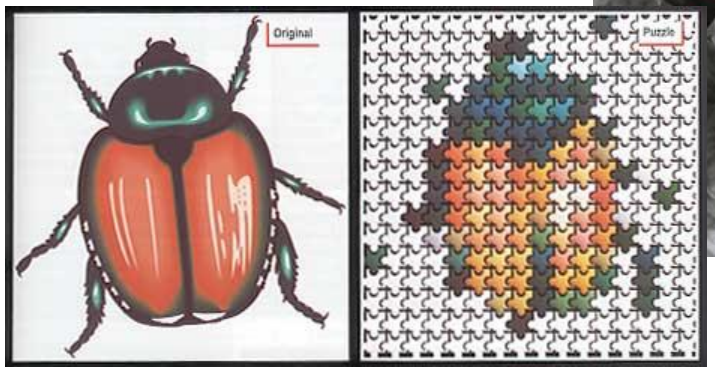
Convolution

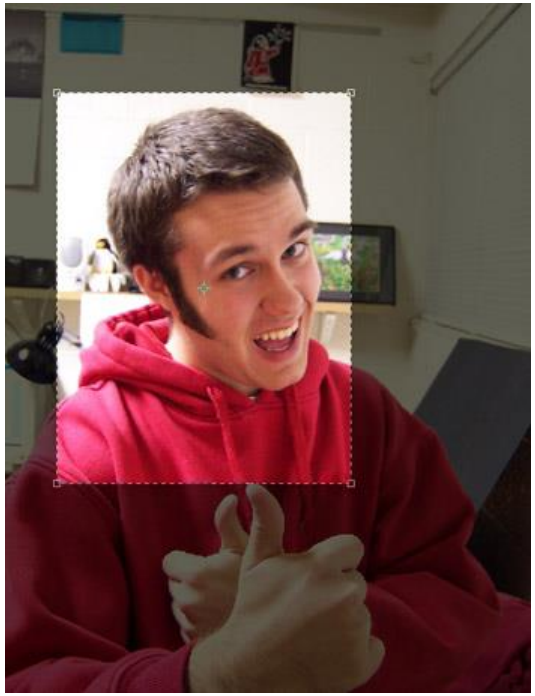



X
X


X
X


X
X


Original
Puzzle




LIVE
LOVE
LAUGH
Before
LIVE
LOVE
LAUGH
After