EE 604
Digital Image Processing

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Indian Institute of Technology, Kanpur

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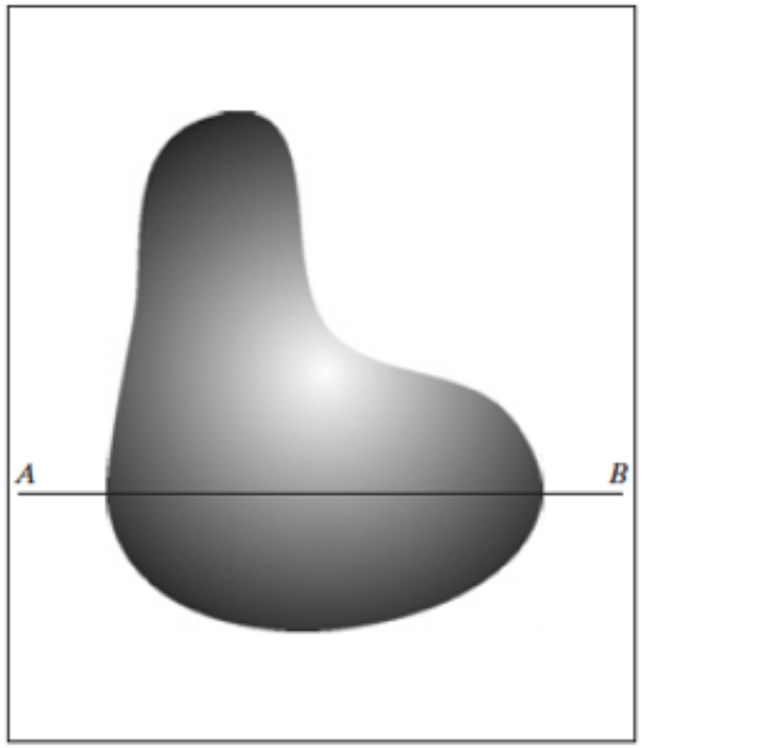
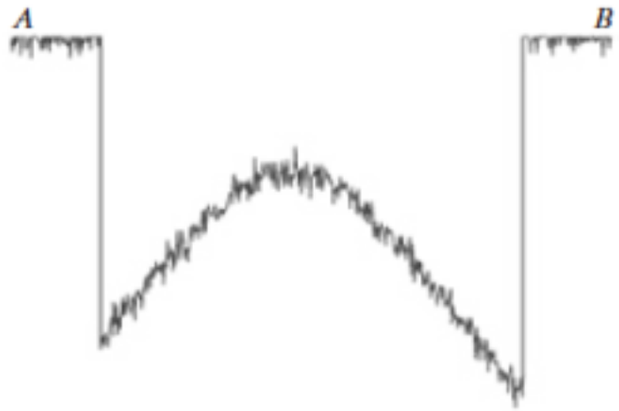
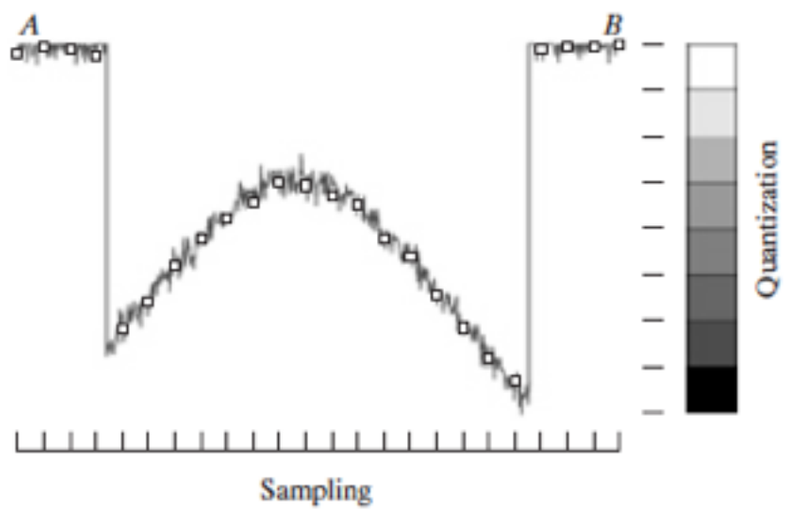
Lecture outline

- **Sampling (contd.)**
- **Quantization**
- **Digital image representation**

Sampling



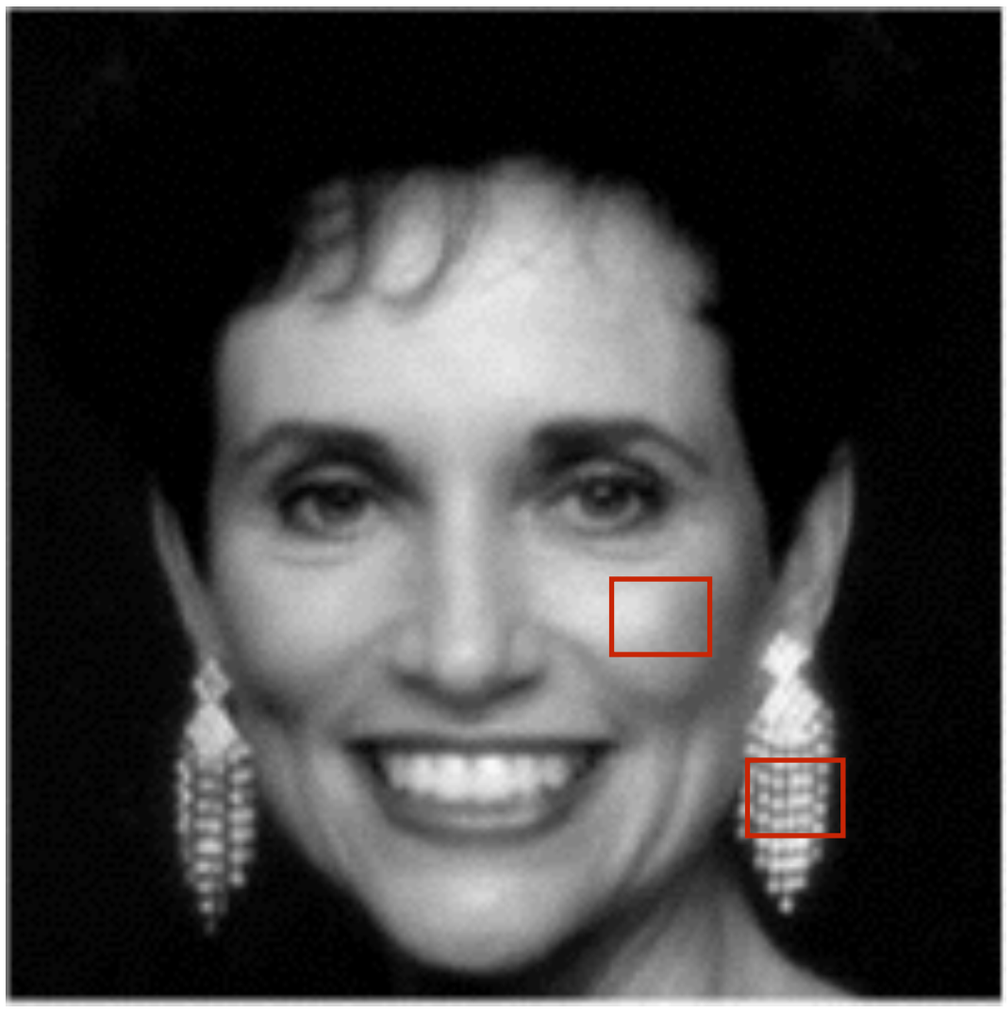




- digitation of space
- determines spatial resolution

Sampling

What is understood by frequency in the context of images?



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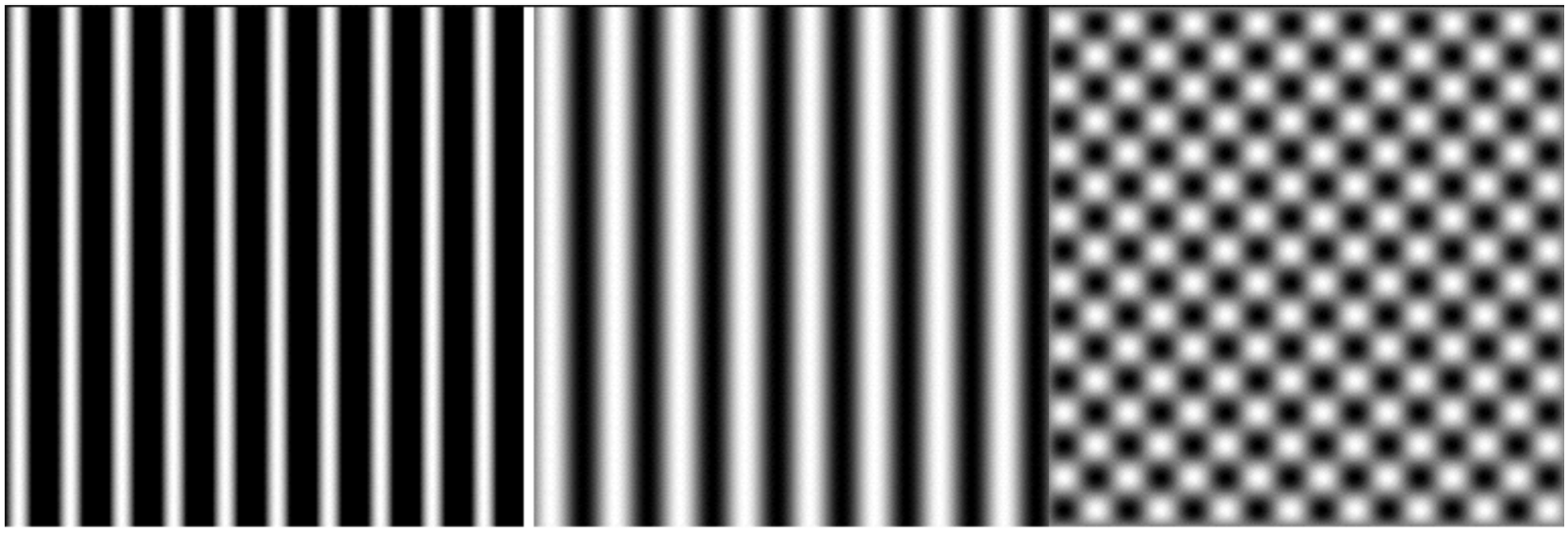

Sampling

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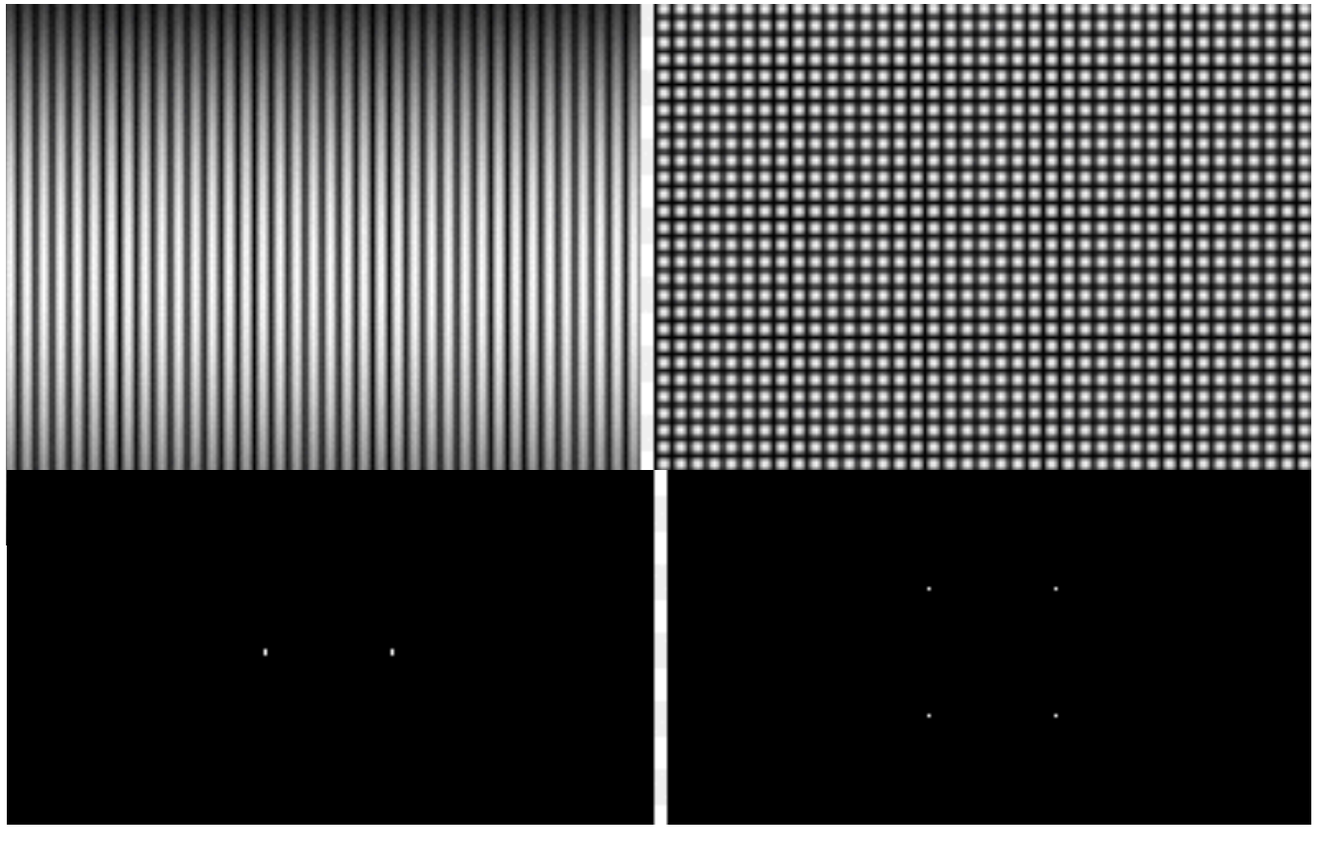


Example

- Example:

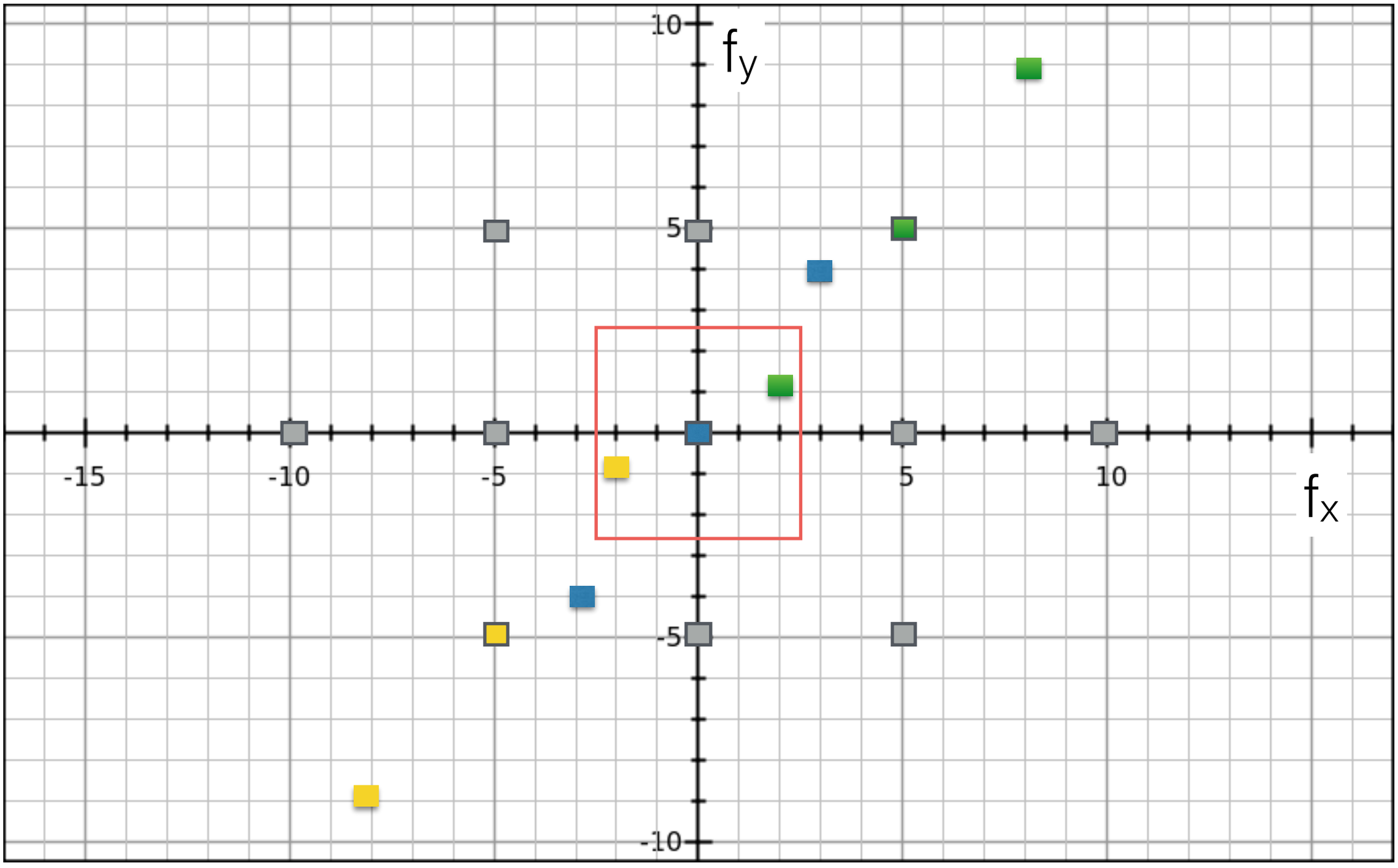
$$f(x,y) = 2\,\cos\,2\pi(3x+4y)$$

$$\Delta x = \Delta y = 0.2$$

- Will it cause aliasing?

- How will the reconstructed spectrum look like?

Sampling



Aliasing in an image

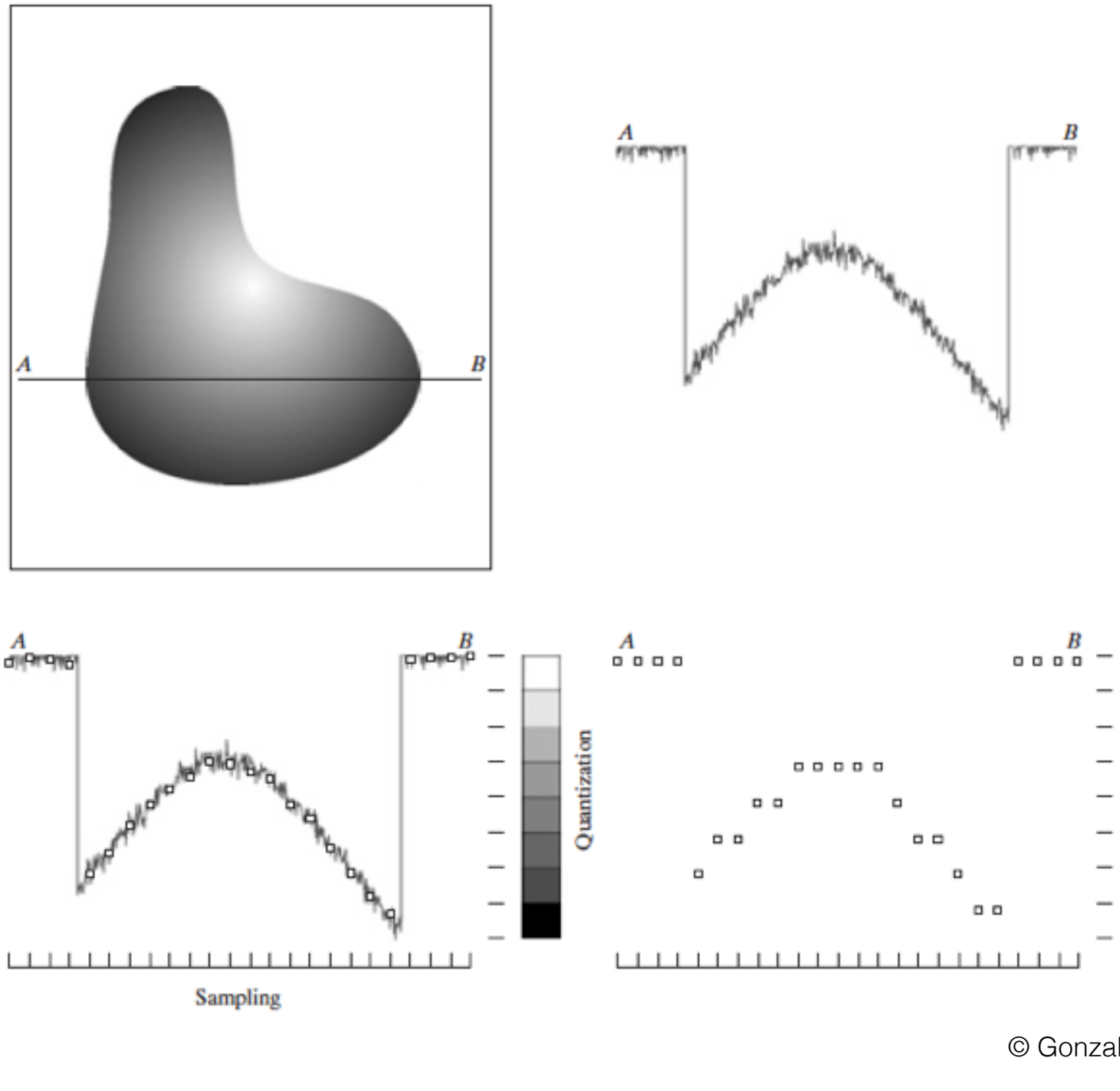
Sampling

- Can we recover the original signal from an aliased spectrum?
- What to do when increasing the sampling rate is not possible?
- Can we do better than uniform sampling?
- Practical limitations of optimal sampling.

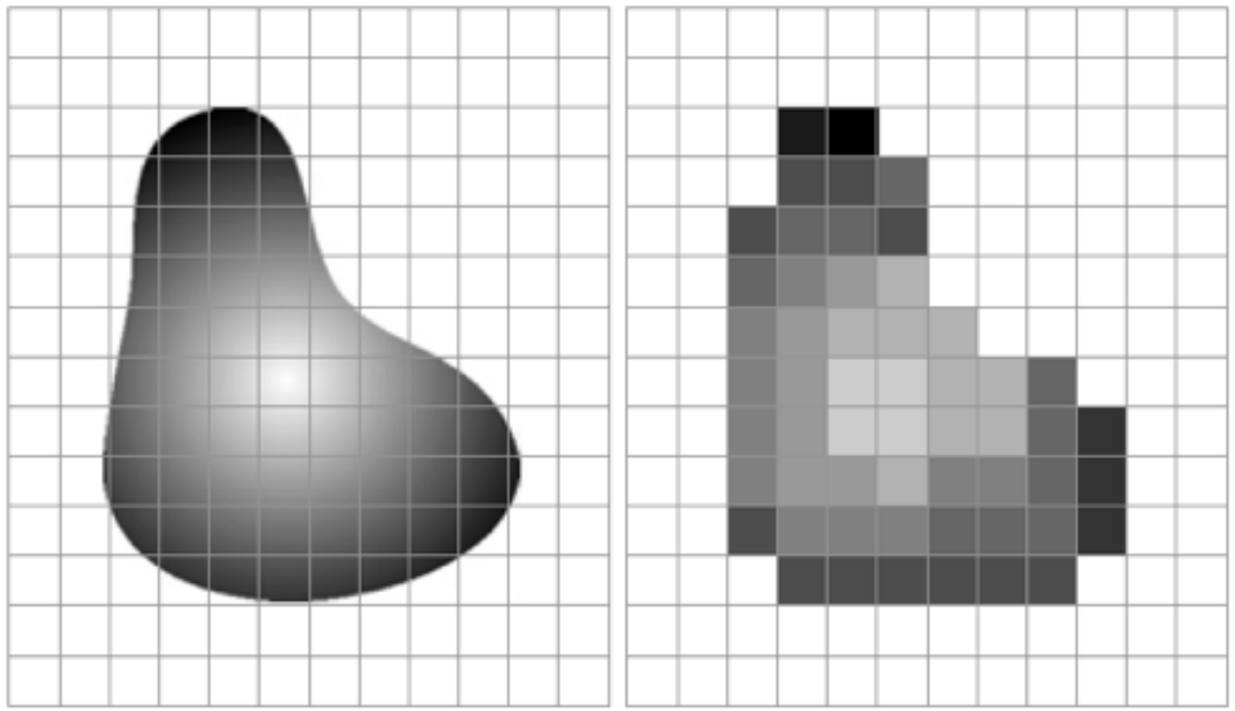
Lecture outline

- Sampling (contd.)
- **Quantization**
- Digital image representation

Quantization



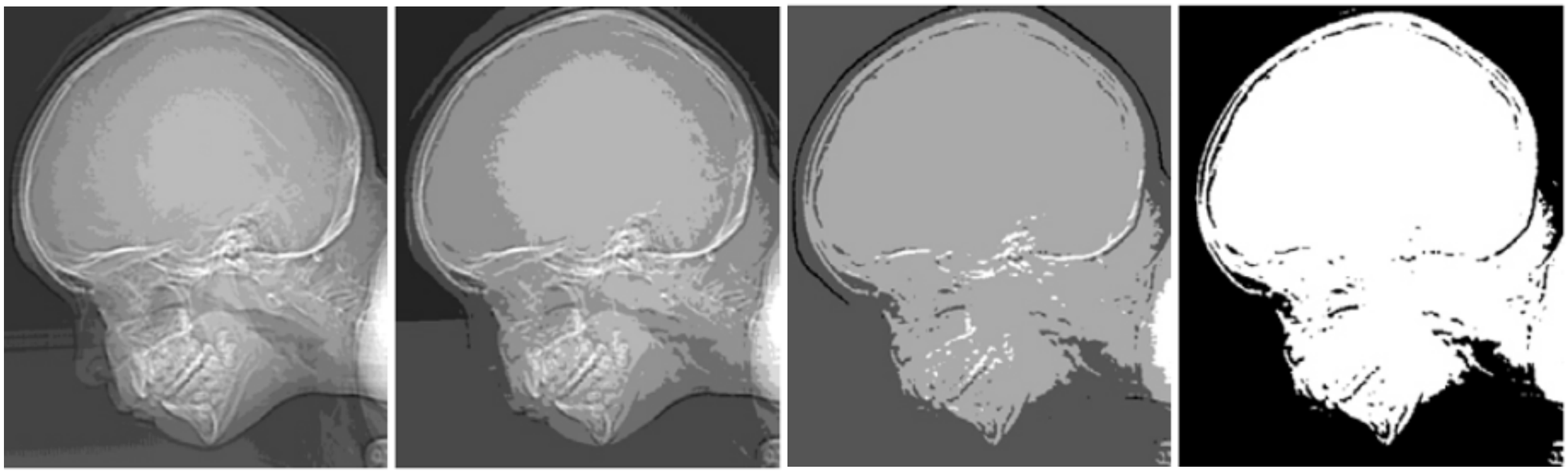
Quantization



Quantization

- **Quantization:** digitization of amplitude (intensity)
- determines gray-level resolution
- Llyod-Max quantization algorithm (class notes)

Graylevel resolution



16 gray levels | 8 gray levels | 4 gray levels | 2 gray levels

storage required for an MxN image with 256 gray levels = MXNx8 bits

Lecture outline

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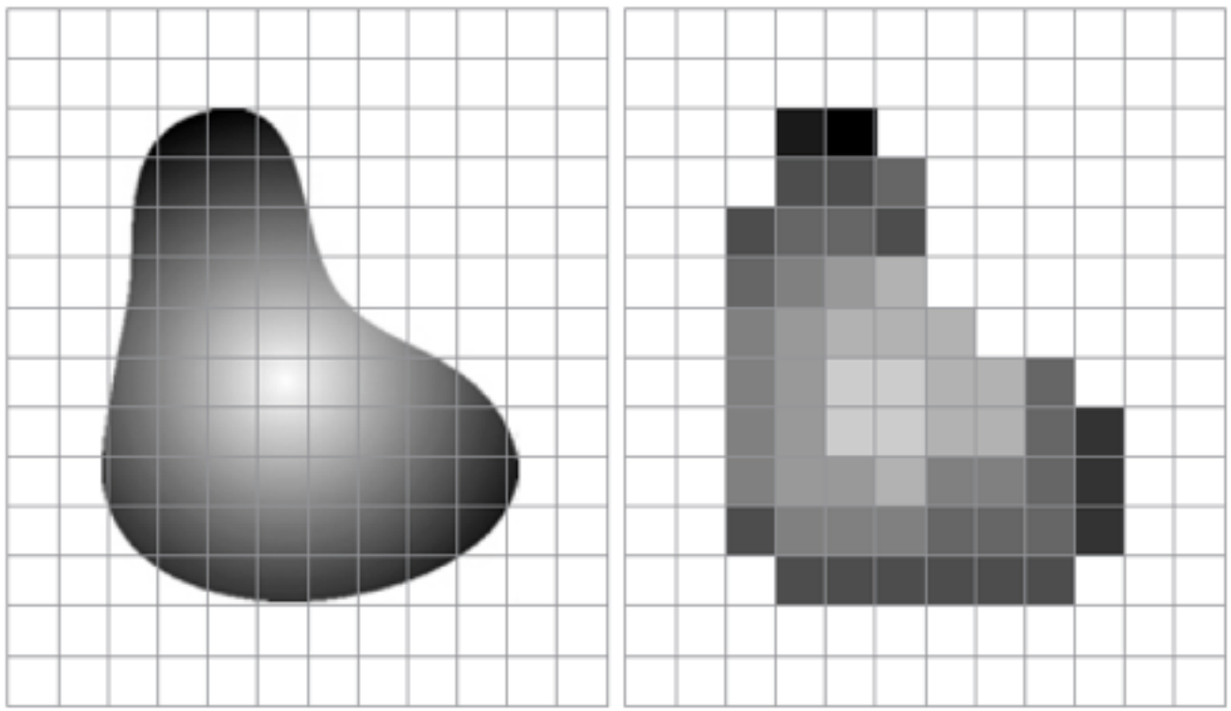
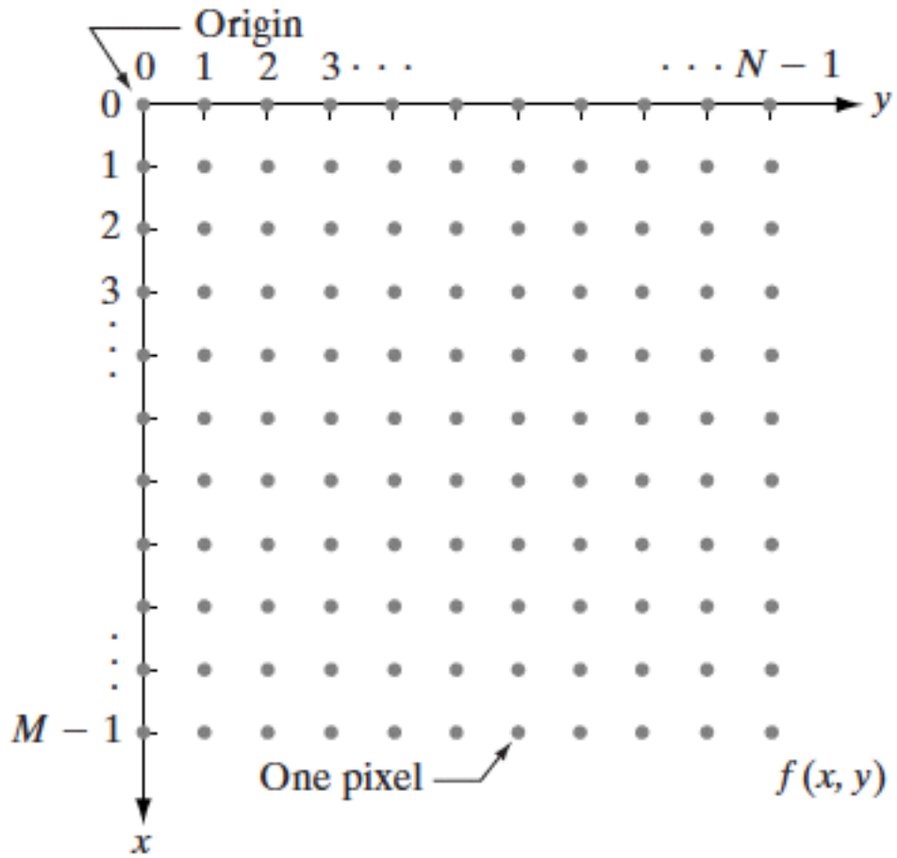
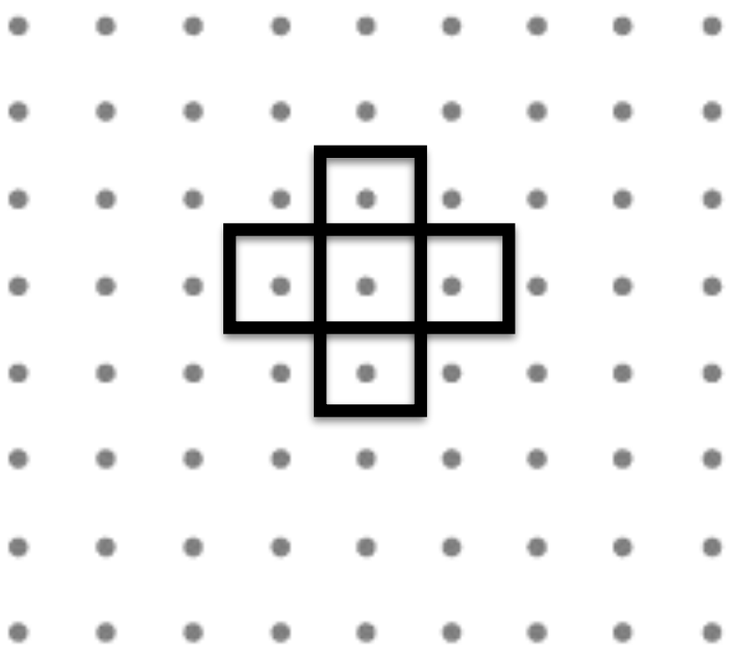
Representing a digital image

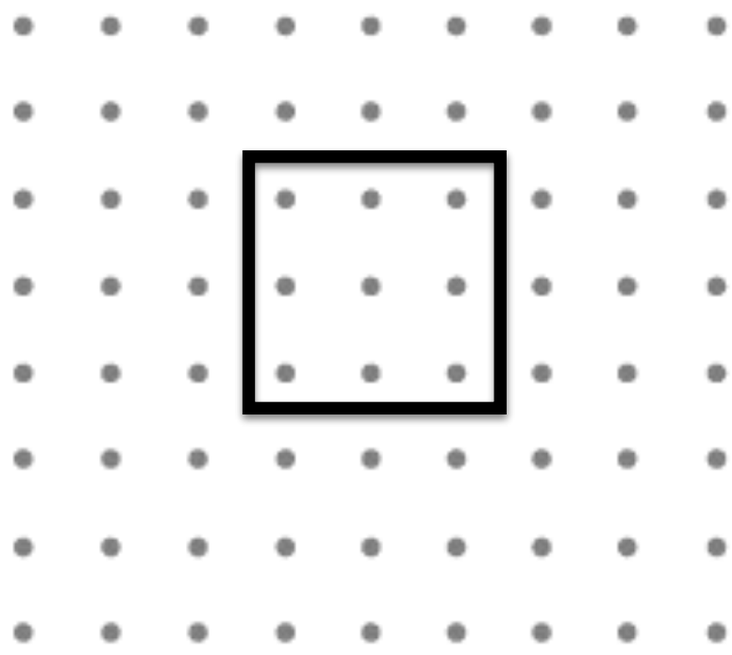




Neighborhoods

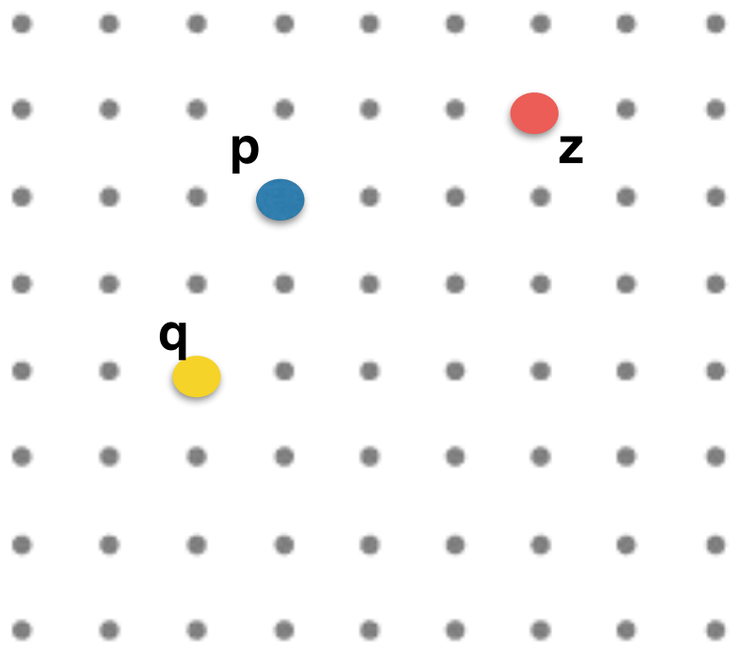


$N_4(p)$



$N_8(p)$

Distance measures



$$D(p, q) \geq 0 \quad \big(D(p, q) = 0 \quad \text{iff} \quad p = q\big)$$
$$D(p, q) = D(q, p), \text{and}$$
$$D(p, z) \leq D(p, q) + D(q, z).$$

$$D_e(p, q) = \big[(x - s)^2 + (y - t)^2\big]^{\frac{1}{2}}.$$

$$D(p, q) = |x - s| + |y - t|.$$