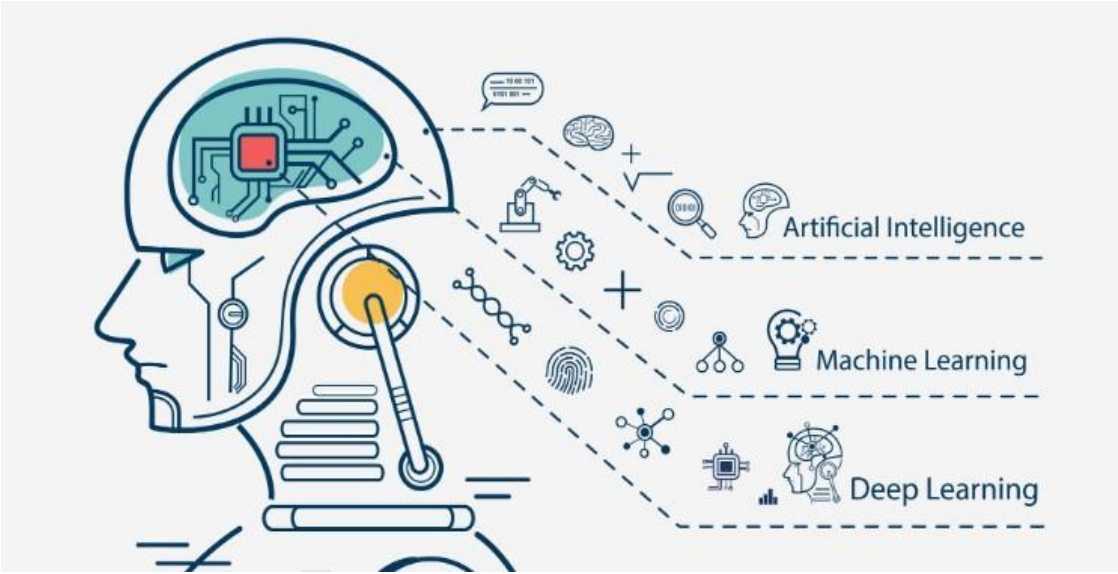
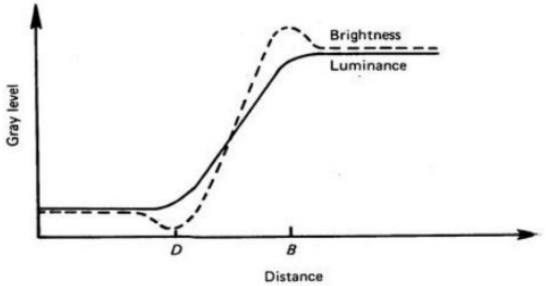
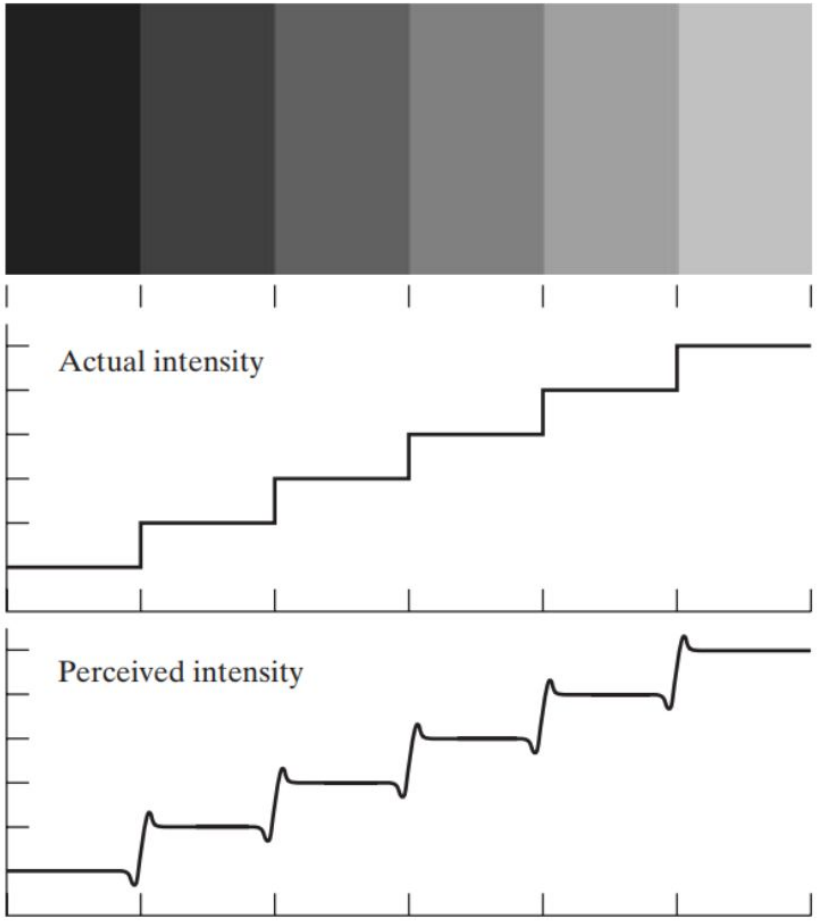
Sampling & Quantization



Mach band effect

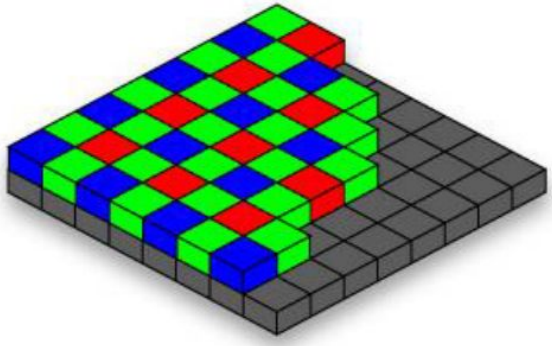
- Human perception
  - Characteristics of HVS



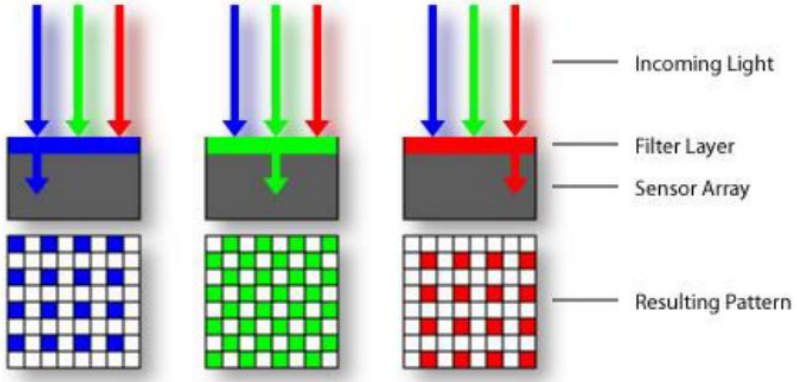


Color sensing

Estimate the color



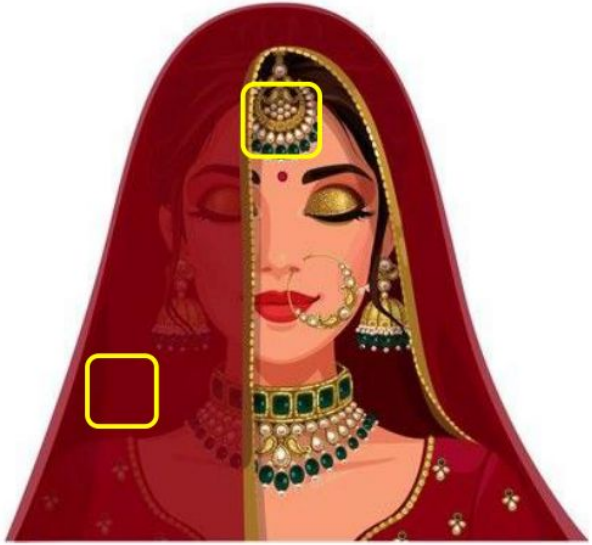
Bayer pattern



Sampling

- Sampling
  - determines spatial resolution
  - space digitization

- Image frequency
  - what are freq contents inside an image?
  - is the uniform sampling optimal?
  - is oversampling useful?
  - strive for efficient sampling
    - sampling density
    - data storage, data transmission



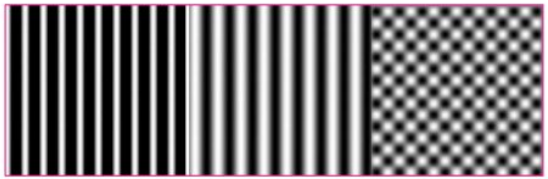
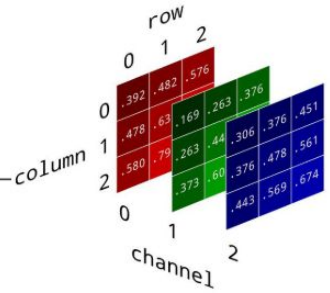
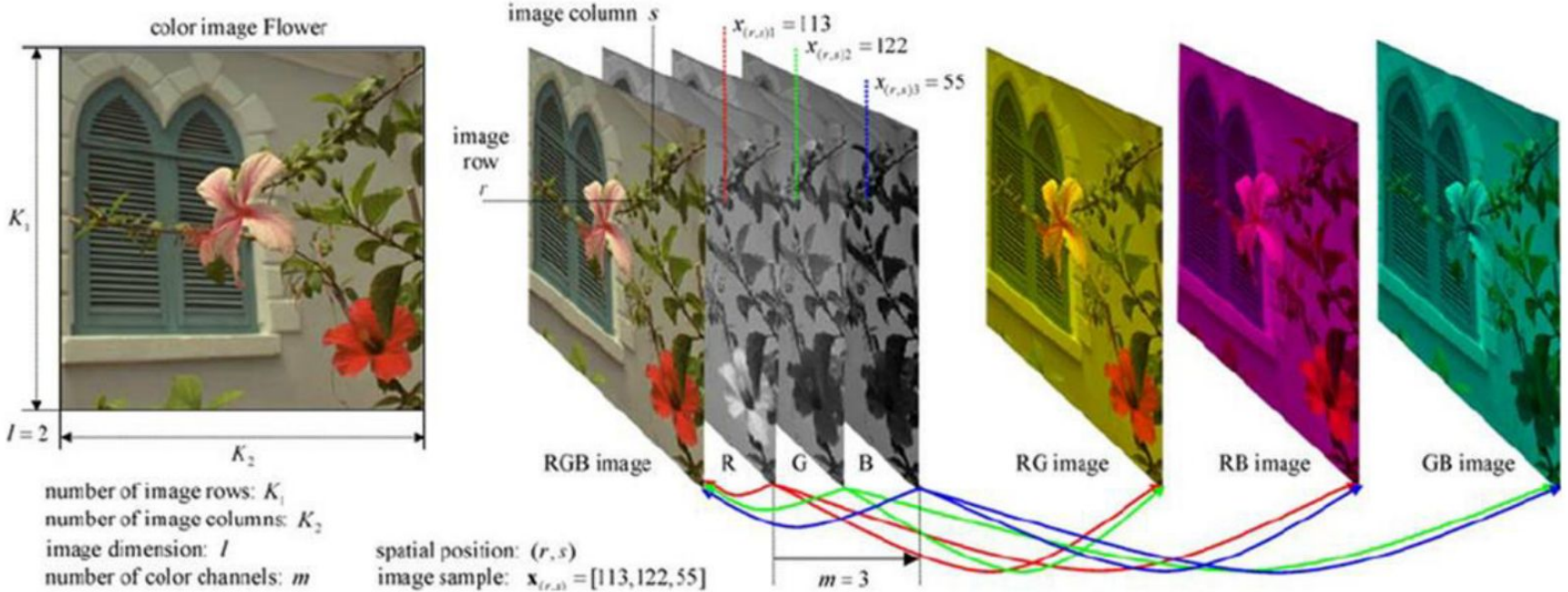


Image representations

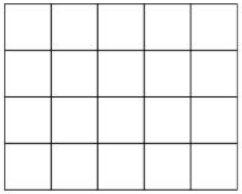


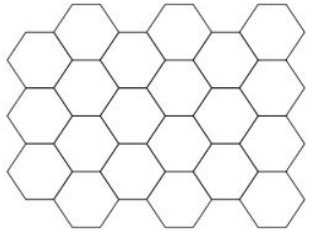


credit: K. Plataniotis

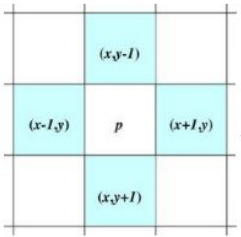
Sampling

- Grid
  - continuous image is digitized at sampling points
  - sampling points ordered in the plane
  - their geometric relation – grid
  - smallest grid point corresponds to – pixel (2D)
  - voxel (3D)

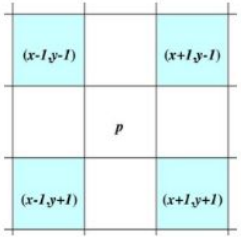




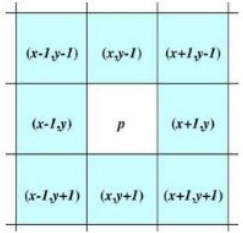
- Neighbourhood



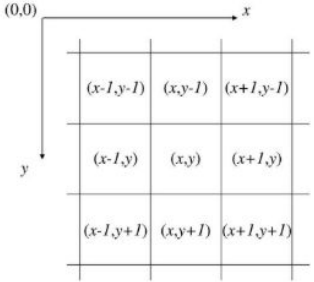
$$N_4(p) = \begin{Bmatrix} (x-1,y) \\ (x+1,y) \\ (x,y-1) \\ (x,y+1) \end{Bmatrix}$$



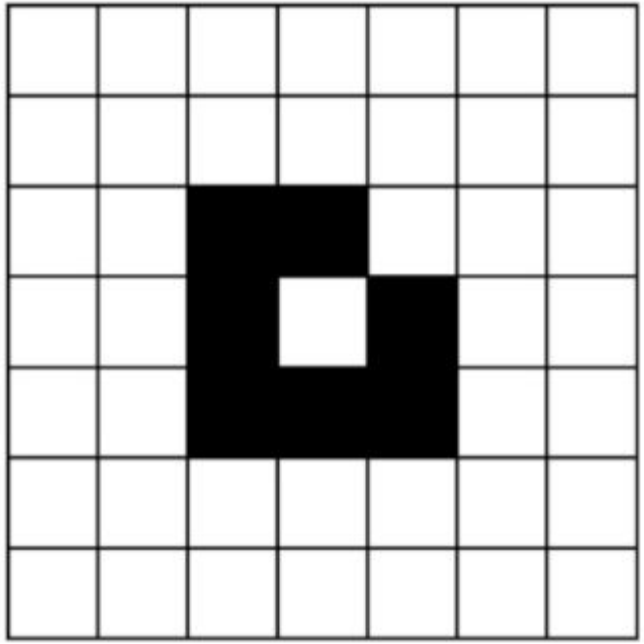
$N_D(p)$

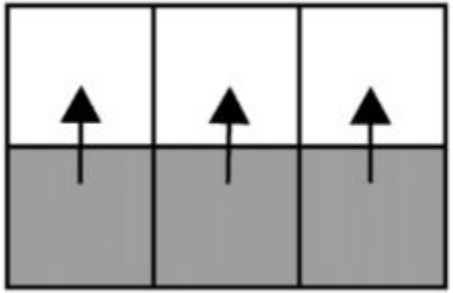


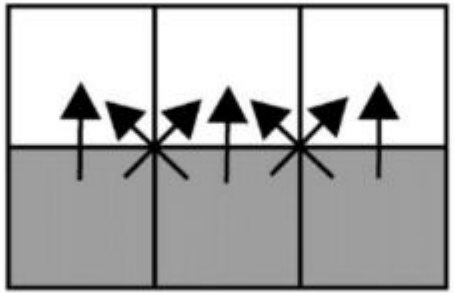
$N_8(p)$

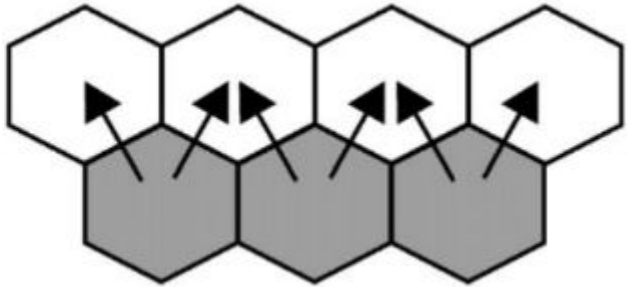


- Neighbour interactions
  - distance, energy, edges, features
  - sq. grid neighbourhood paradox
    - N_4: broken ring encloses
    - N_8: complete ring without enclosure



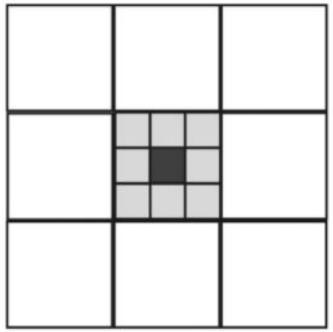


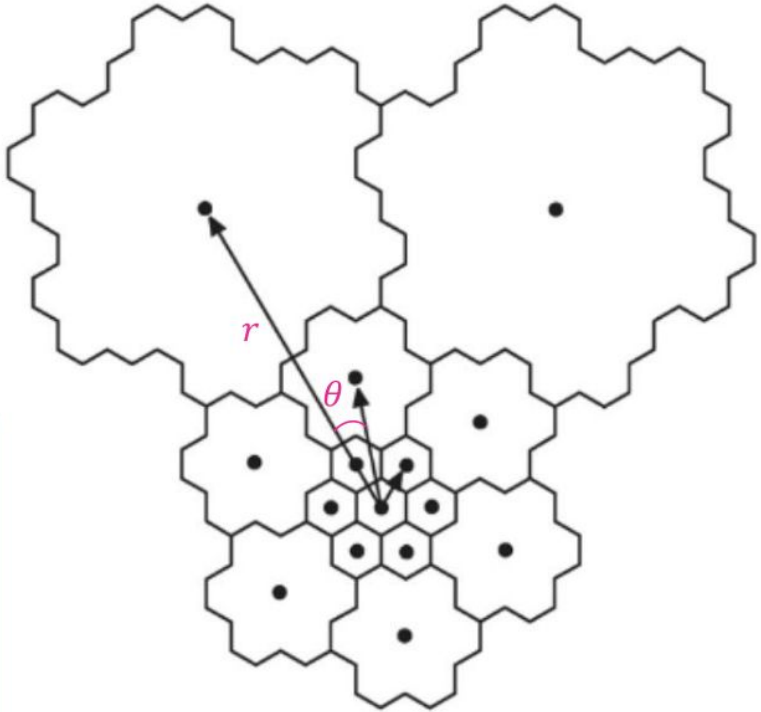




Sampling

- Hierarchical grids
  - neighbours at finer scale become focal cell or centroids for coarser scale
  - smooth out or simplify some grids
    - dynamic grid resolution
  - θ, r can be used to find out current resolution scale

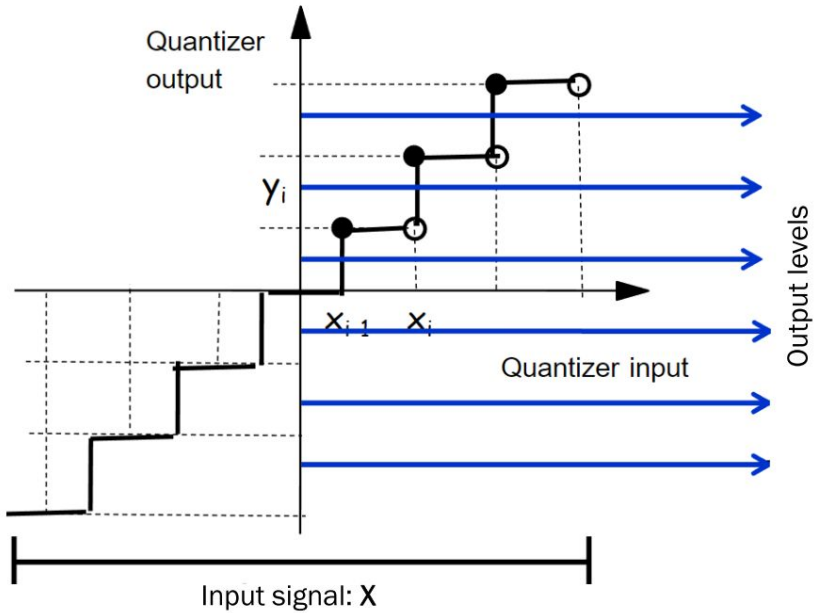




Quantization

- Quantizer
  - SISO – scalar quantizer
  - mappings $[x_{i-1}, x_i) \rightarrow y_i$
  - what are the unknowns?

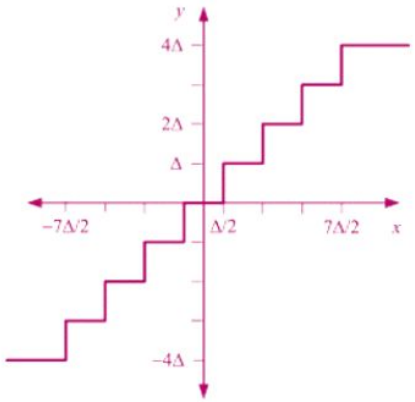
$$x \in [t_k, t_{k+1}) \Rightarrow Q(x) = r_k$$



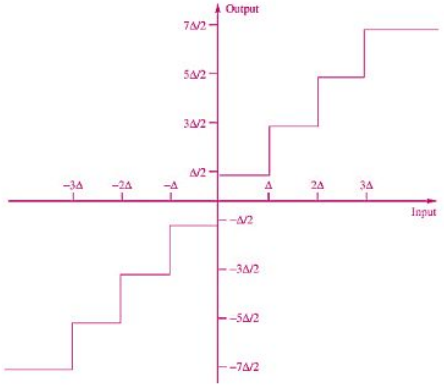
Quantization

- Uniform quantizers
  - all ranges divided equally with $\Delta = [t_k, t_{k+1})$ intervals
  - deadzone

Midtread quantizer

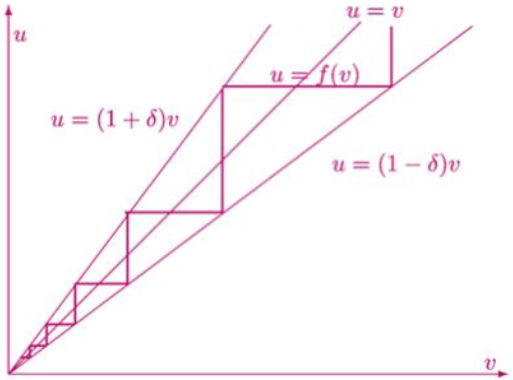


Midrise quantizer

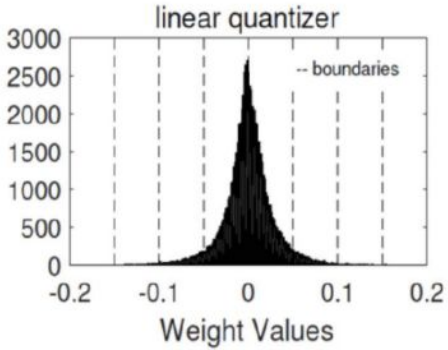


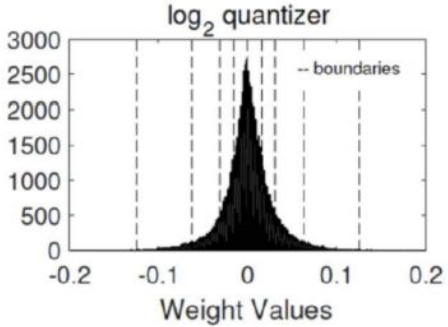
- Non-uniform quantizers
  - ranges divided via predefined function which gives Δ intervals

Logarithmic quantizer



Logarithmic quantizer for image filter weights





THANK YOU