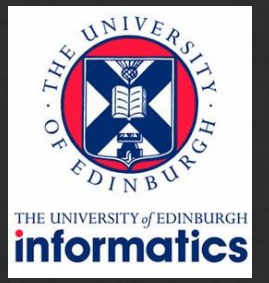


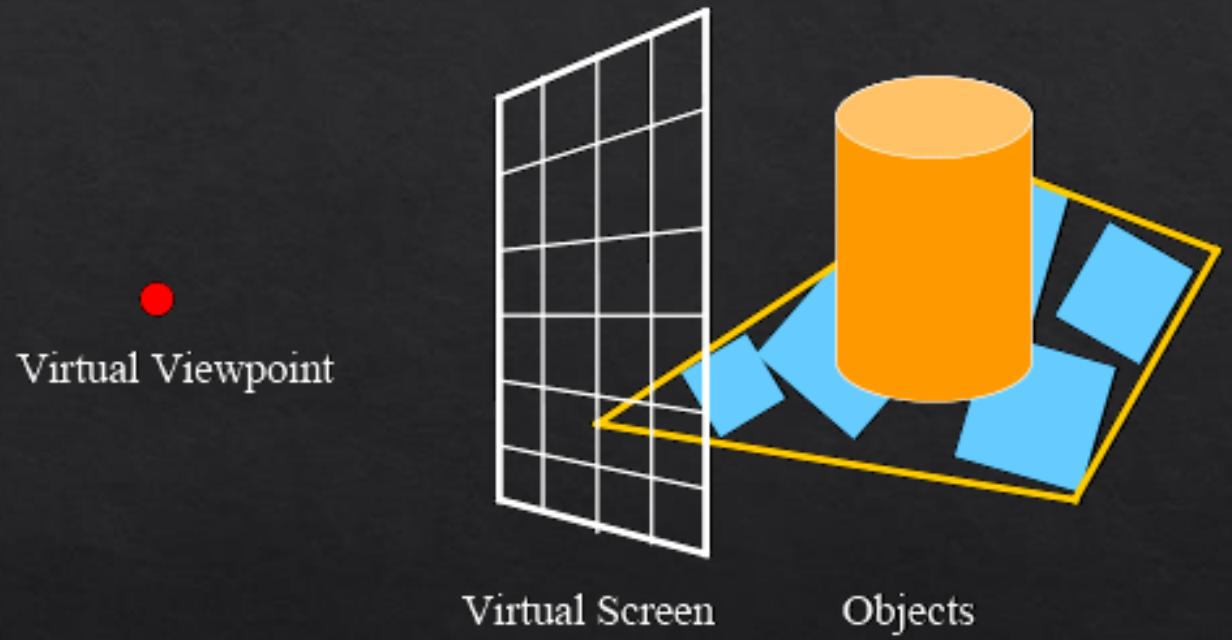
Computer Graphics

Lecture 6: Raytracing - advanced

Kartic Subr

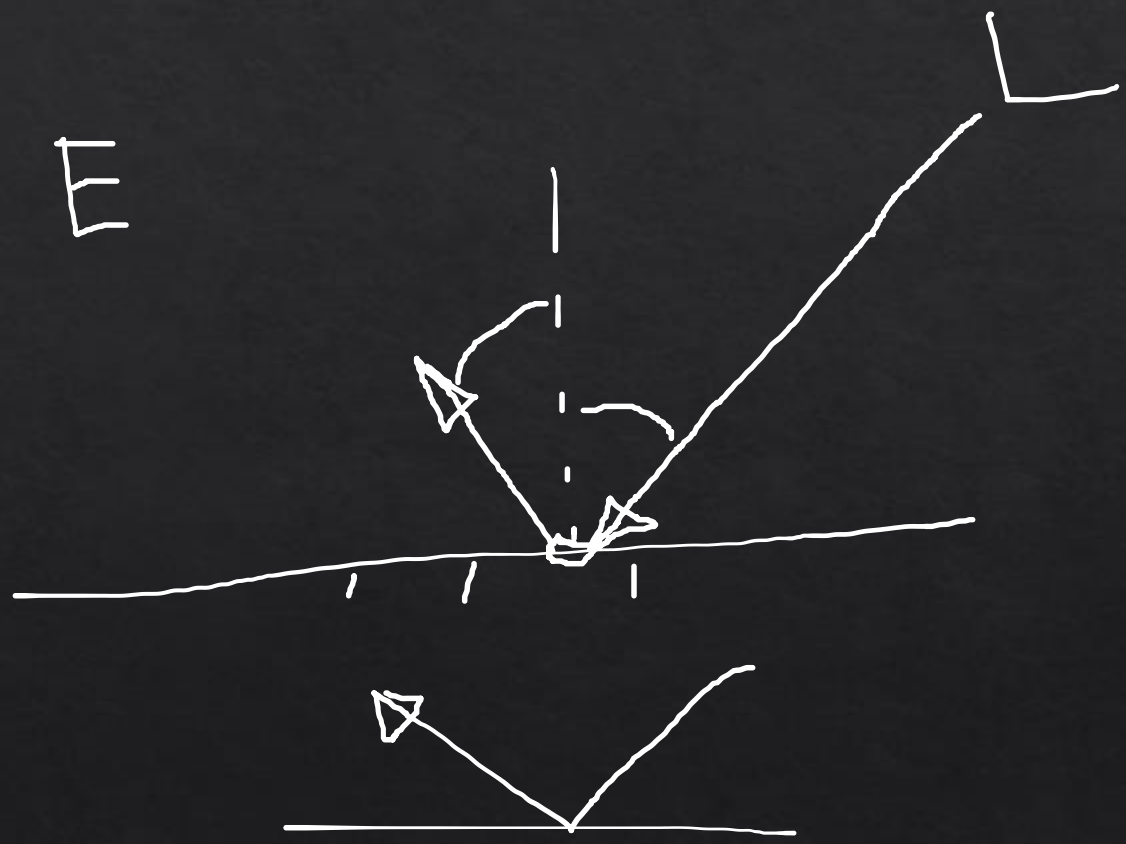
Recap

Ray Casting

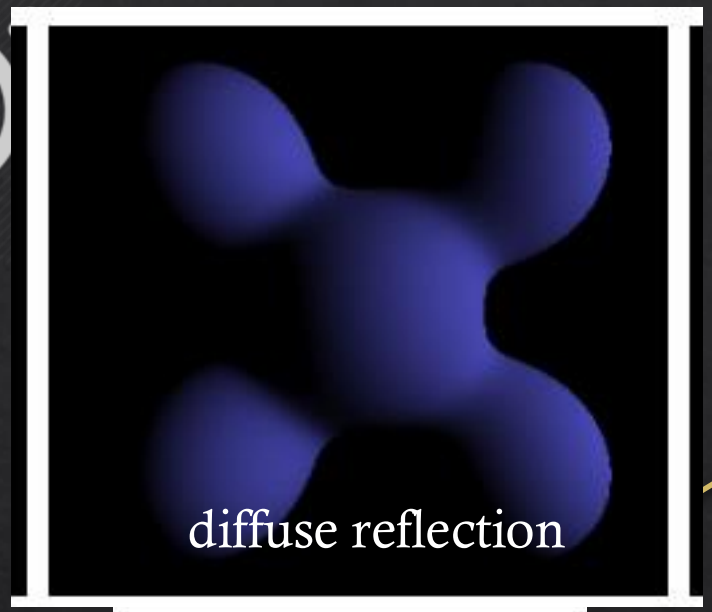


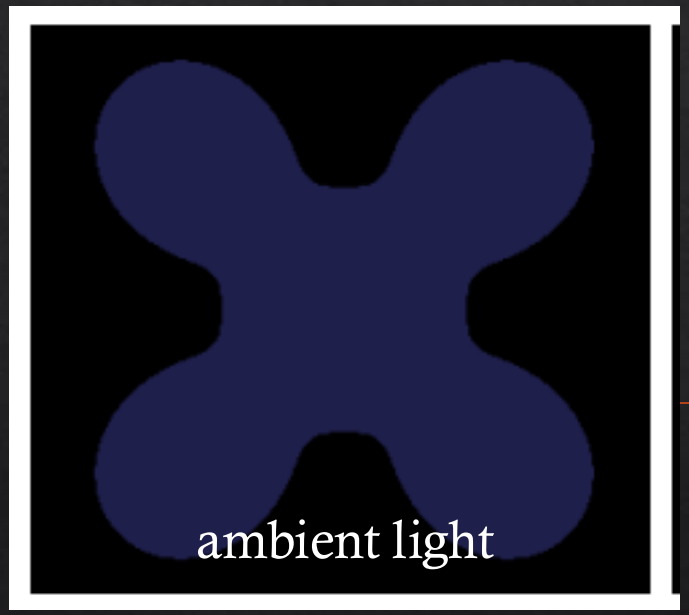
Recap

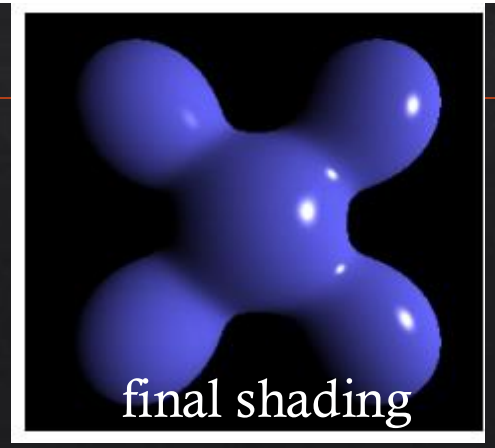
for each pixel p
    trace ray
    shade hit point

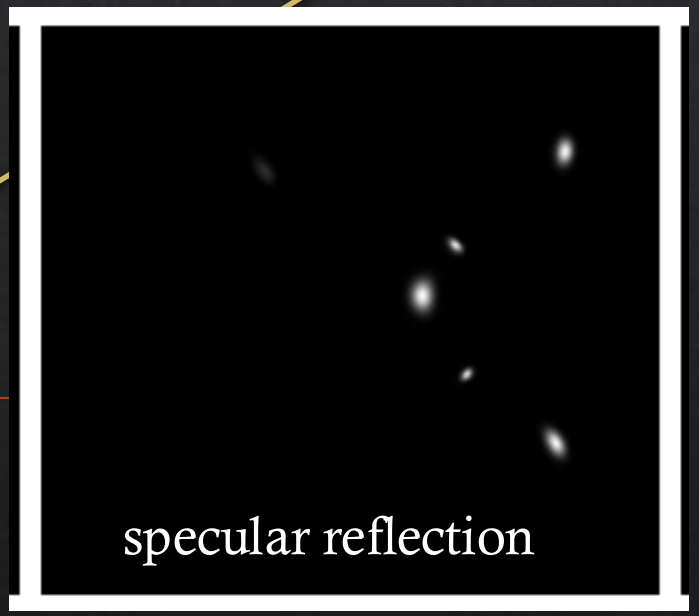


Shading

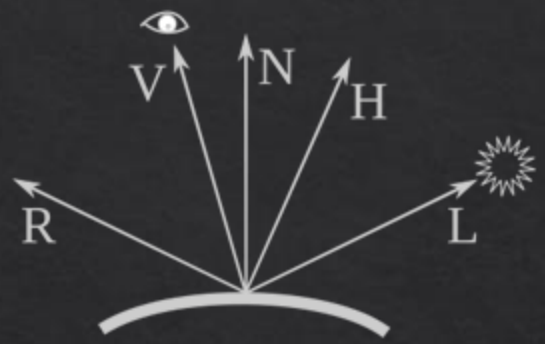

diffuse reflection


ambient light


final shading


specular reflection

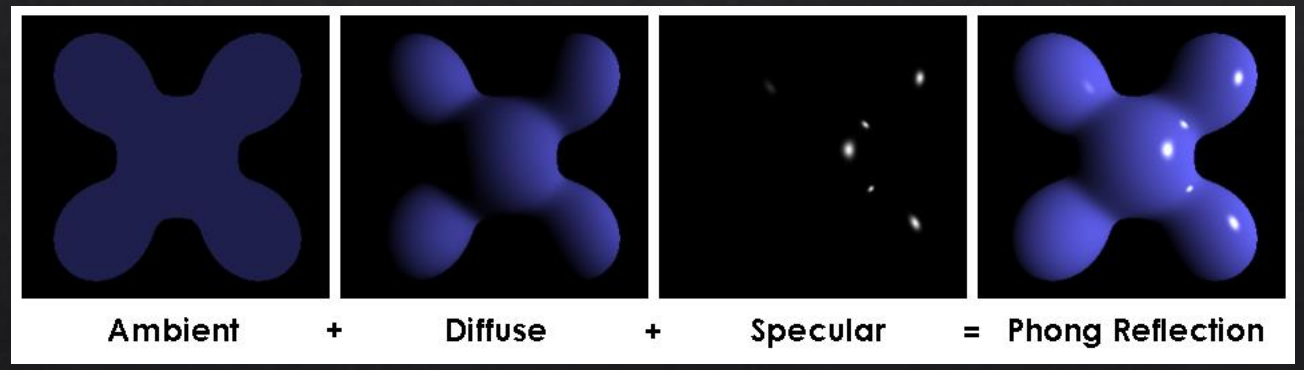
Phong shading



material property

$$I_\mathrm{p} = k_\mathrm{a} i_\mathrm{a} + \sum_{m \in \text{lights}} \left(k_\mathrm{d} (\hat{L}_m \cdot \hat{N}) i_{m,\mathrm{d}} + k_\mathrm{s} (\hat{R}_m \cdot \hat{V})^\alpha i_{m,\mathrm{s}} \right)$$

ambient — diffuse — specular



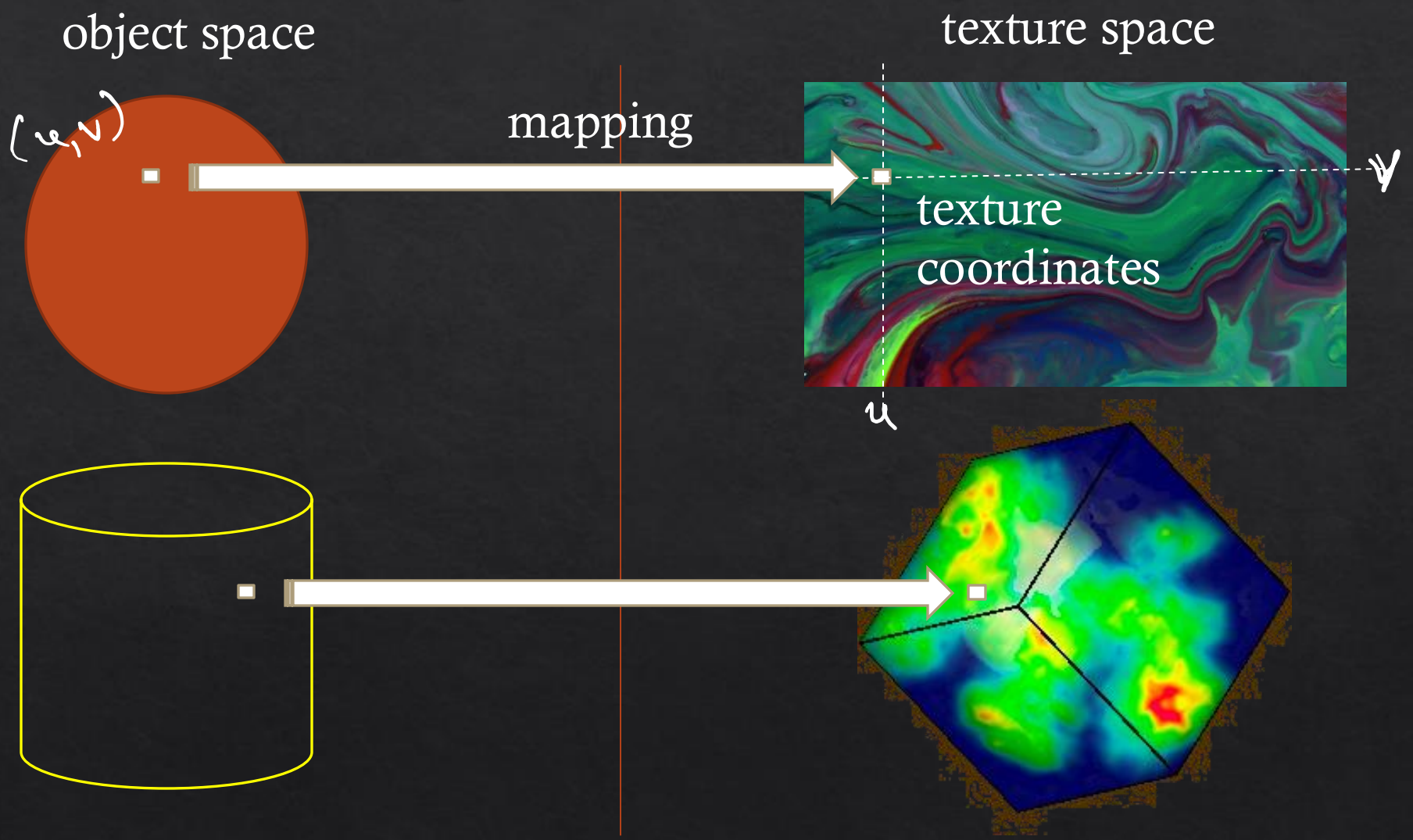
source:wikipedia

light property

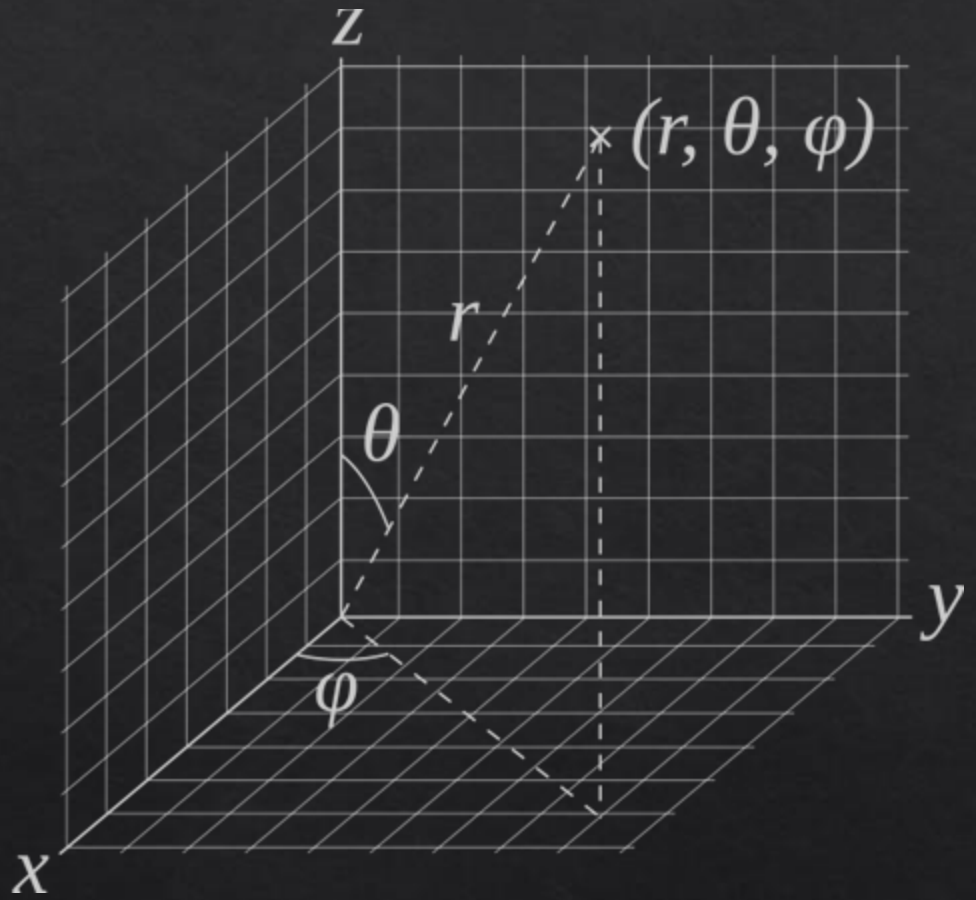
R is the mirror reflection direction

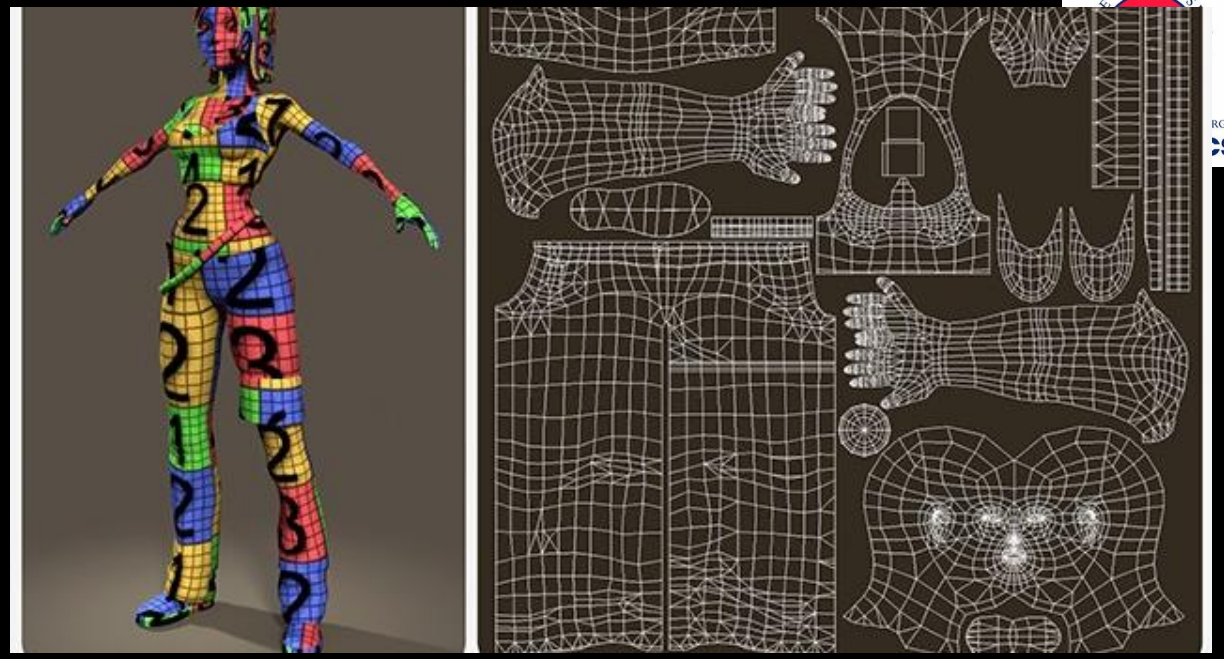
How to deal with texture?

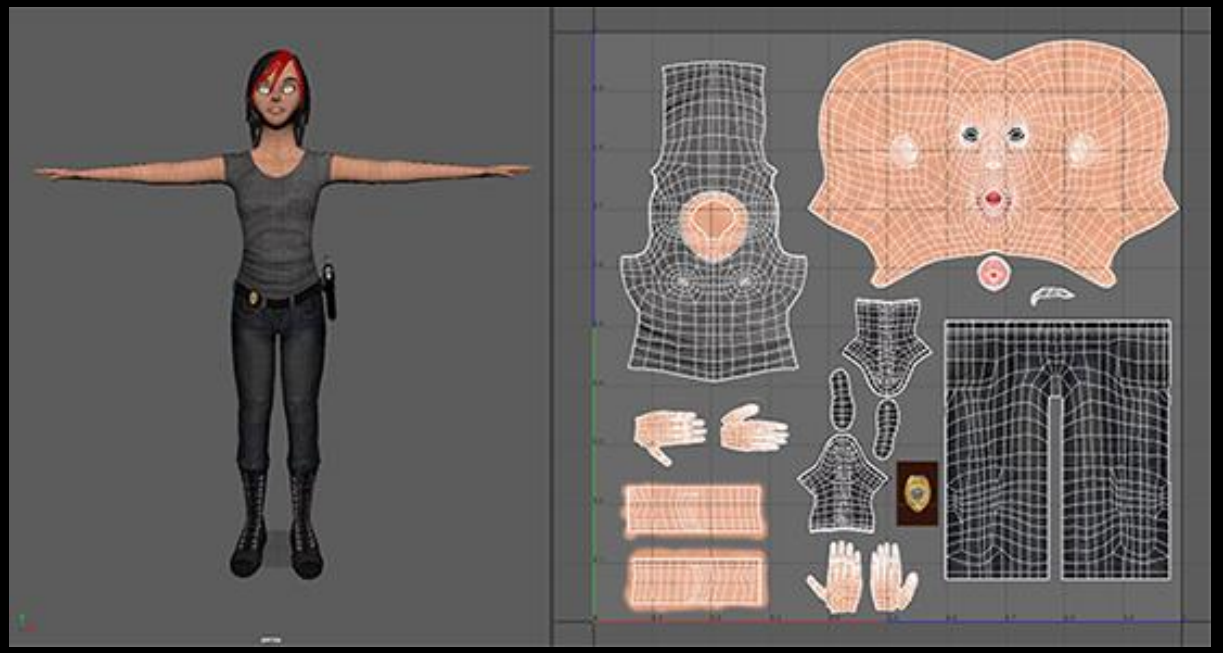
How to deal with texture?

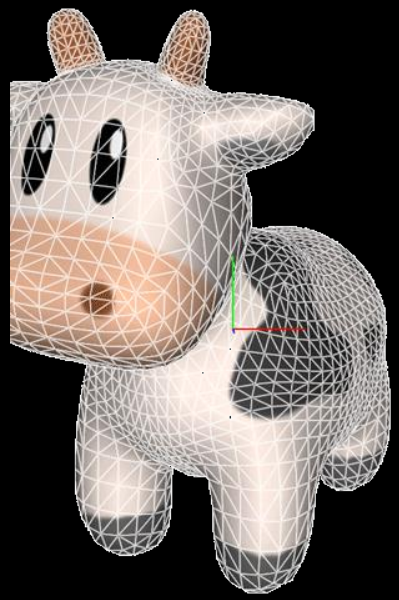


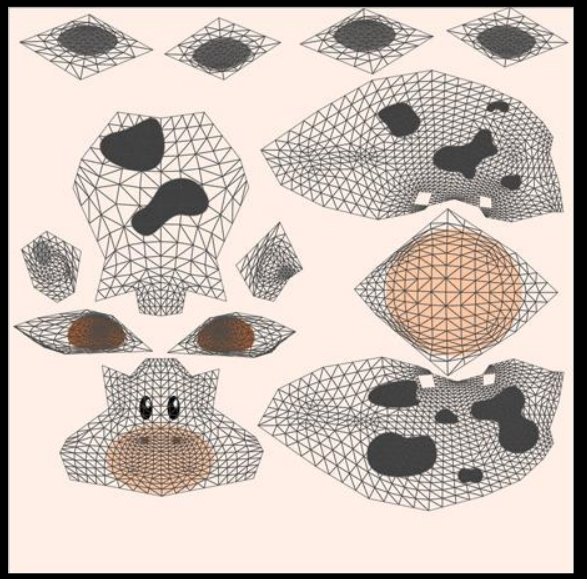
Texture coordinates on a sphere





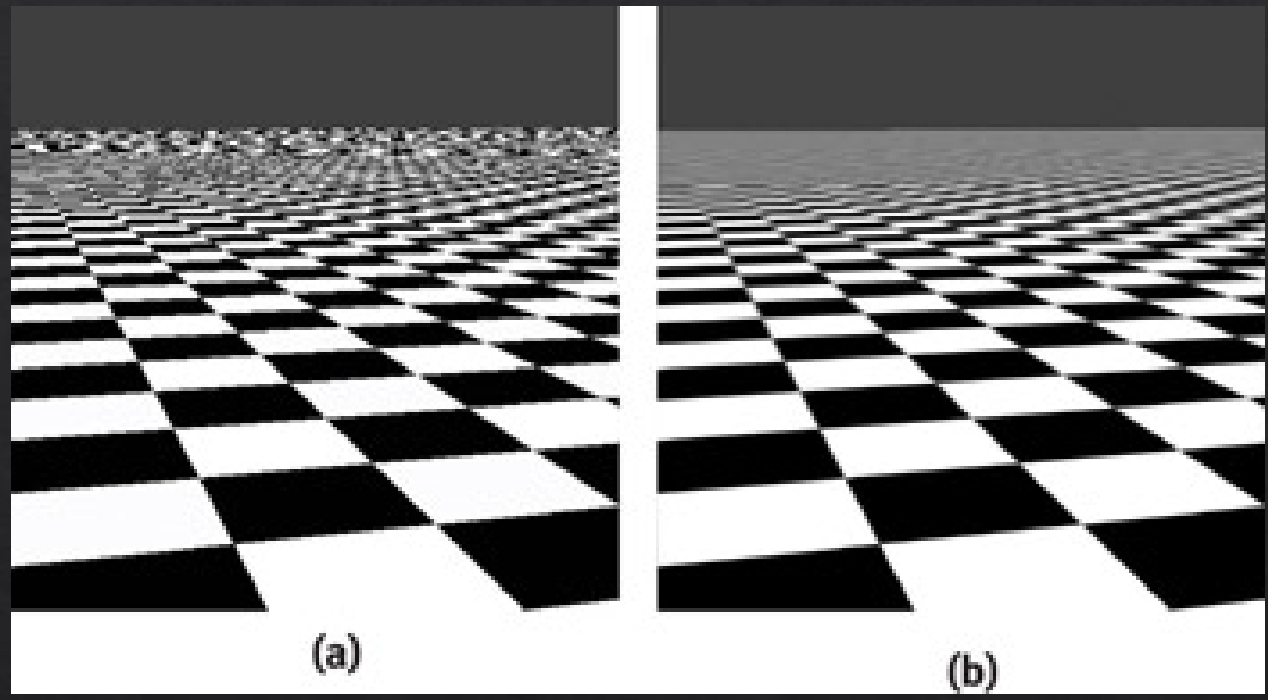






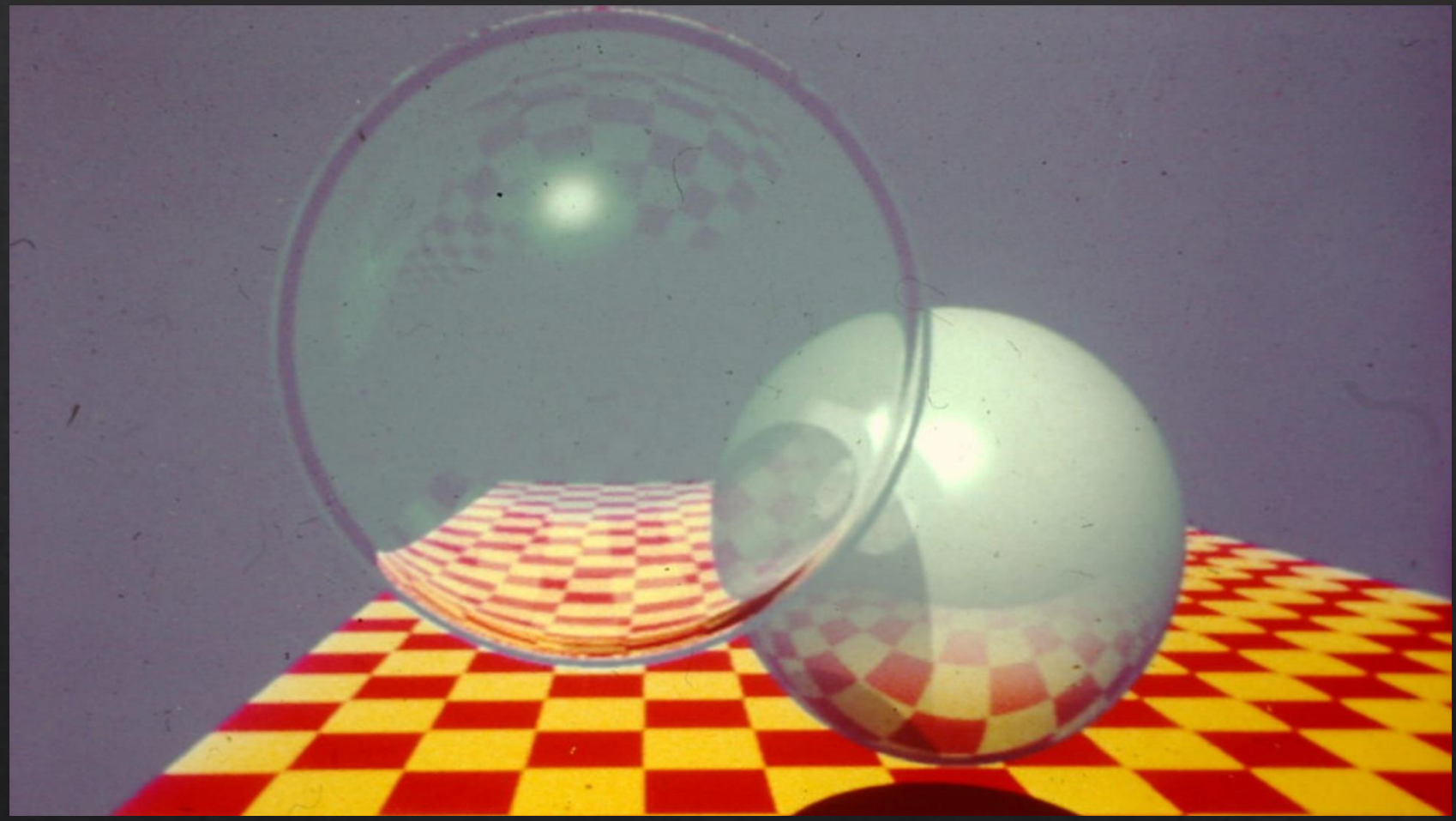
Problems

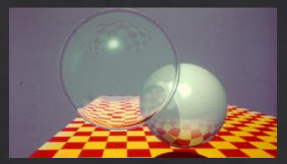
- How to generate maps?
- Finite resolution
- Artifacts
- More later!



http://www.cemyuksel.com/courses/conferences/siggraph2017-rethinking_texture_mapping/rethinking_texture_mapping_course_notes.pdf

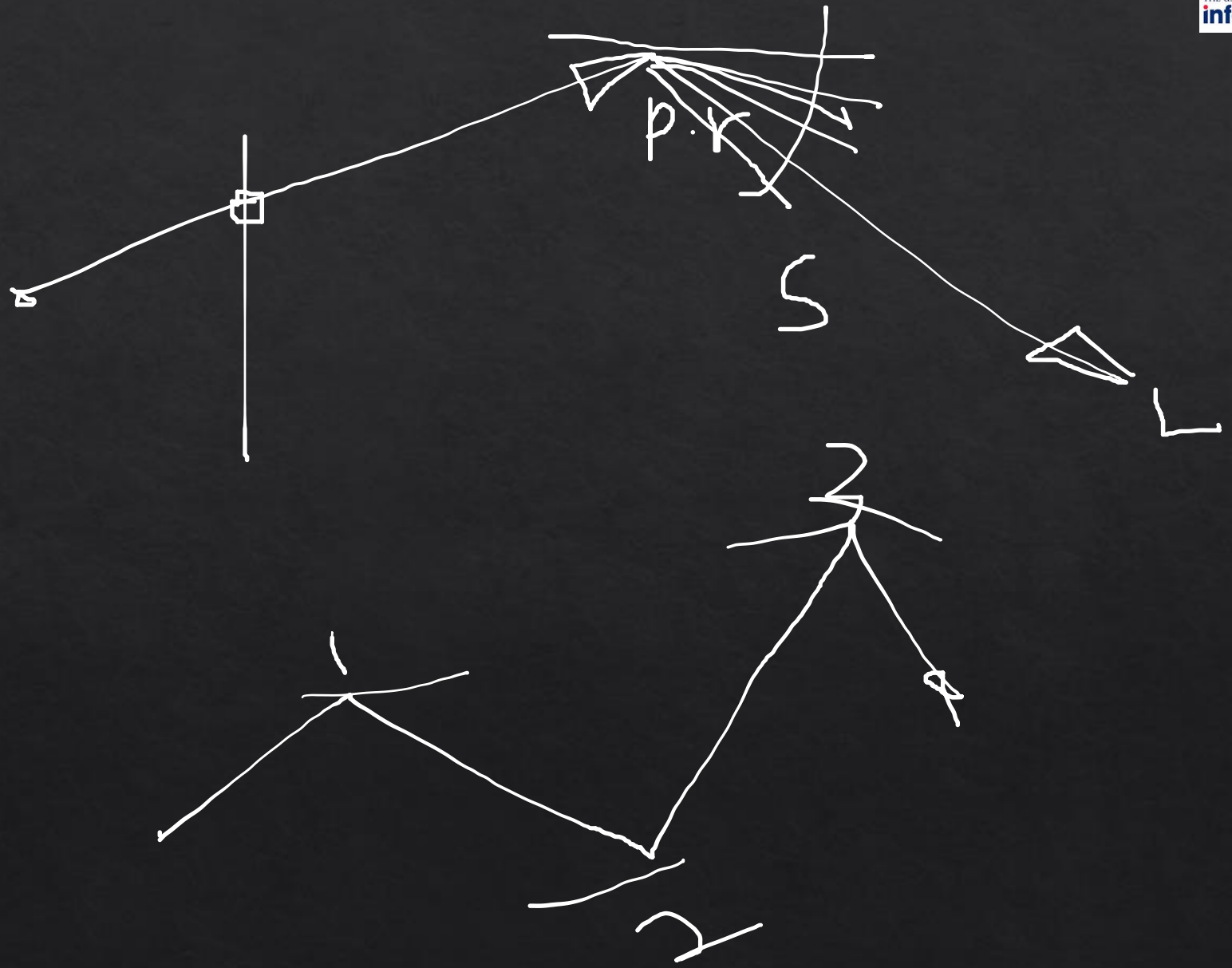
What's wrong with this image?



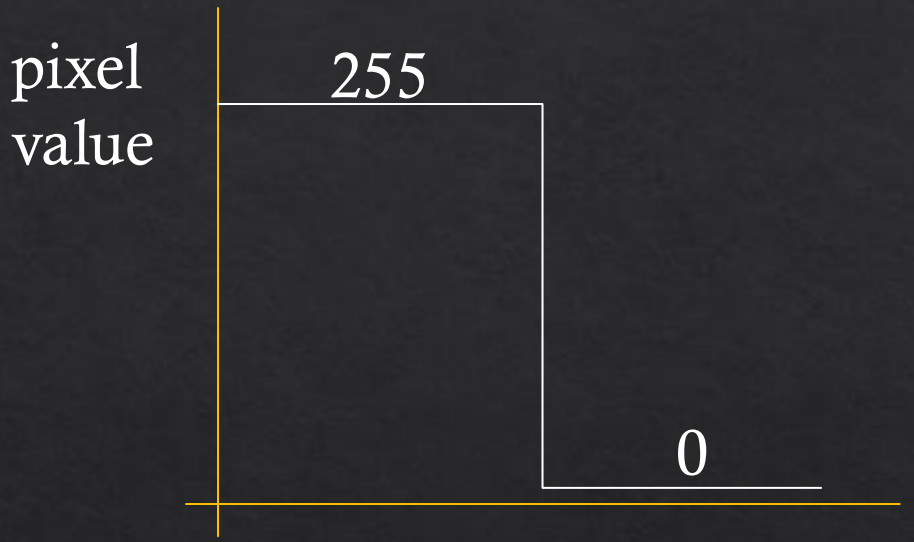


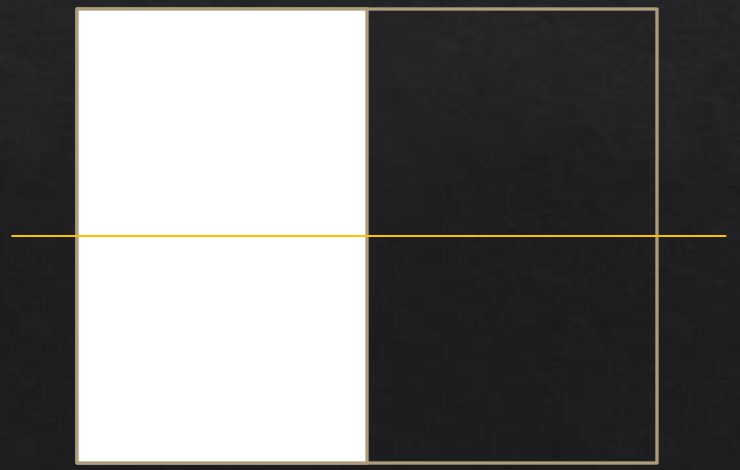
Does not have any blur!

What causes blur?



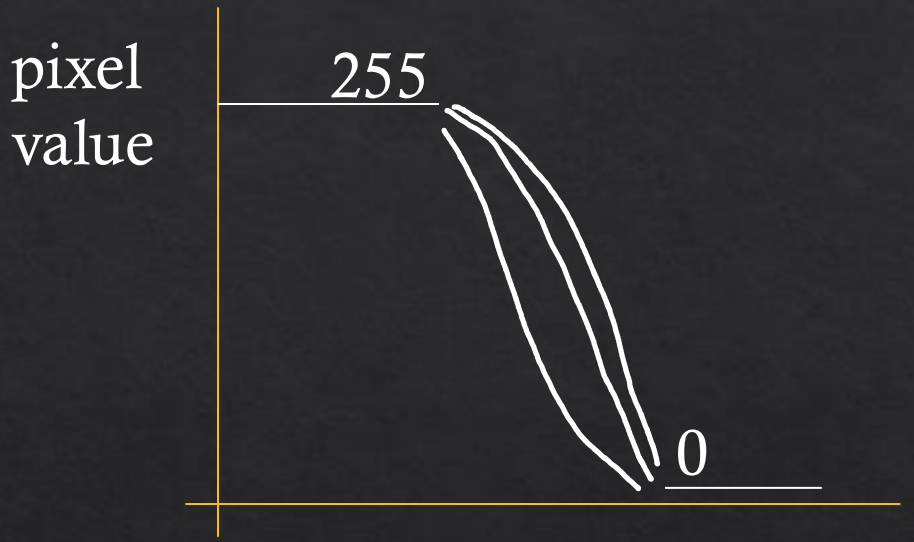
A step function (edge)

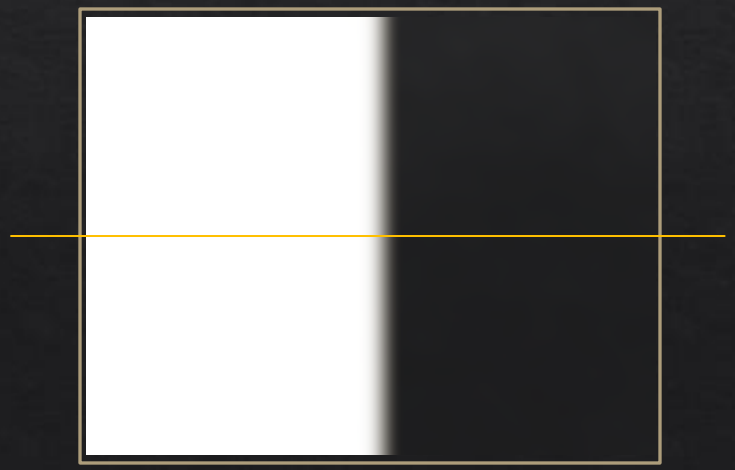




image

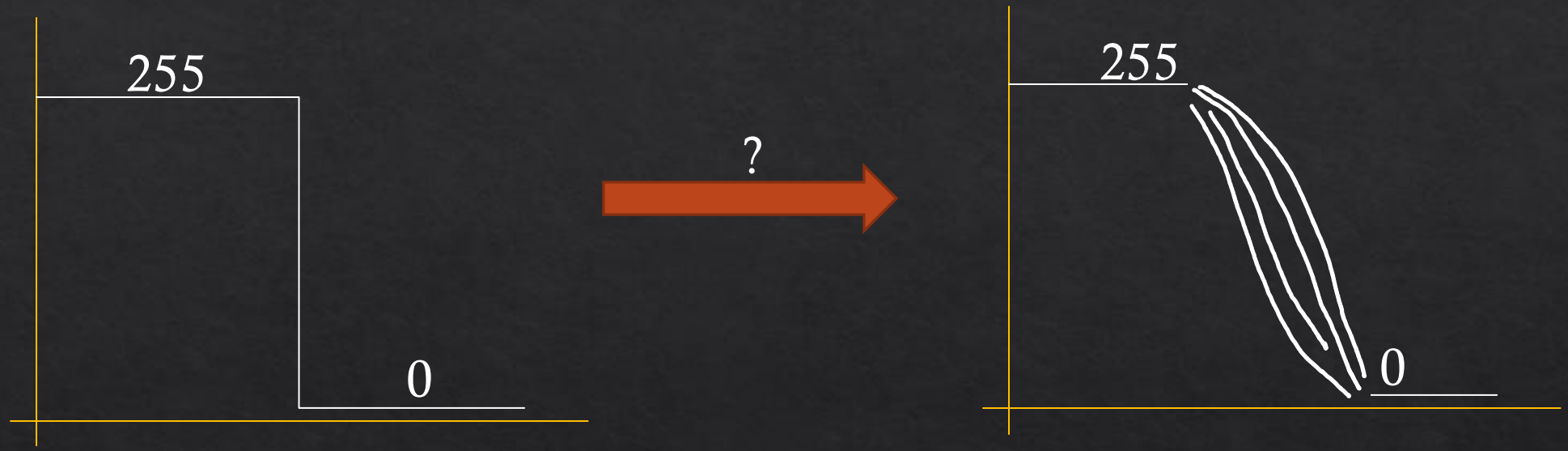
A blurred step function



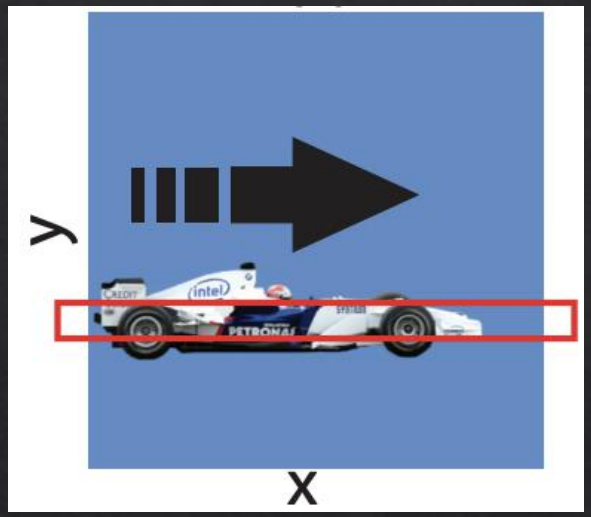


image

Fundamental operation?



Example: photo of a car

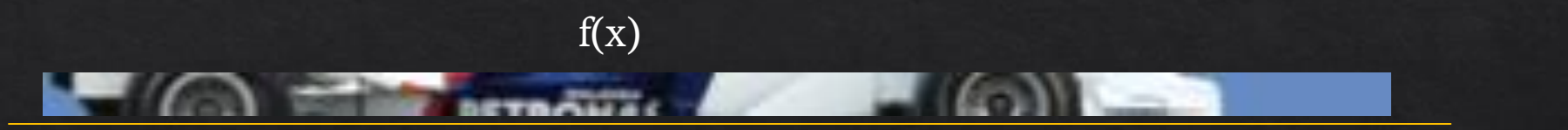


slice in y

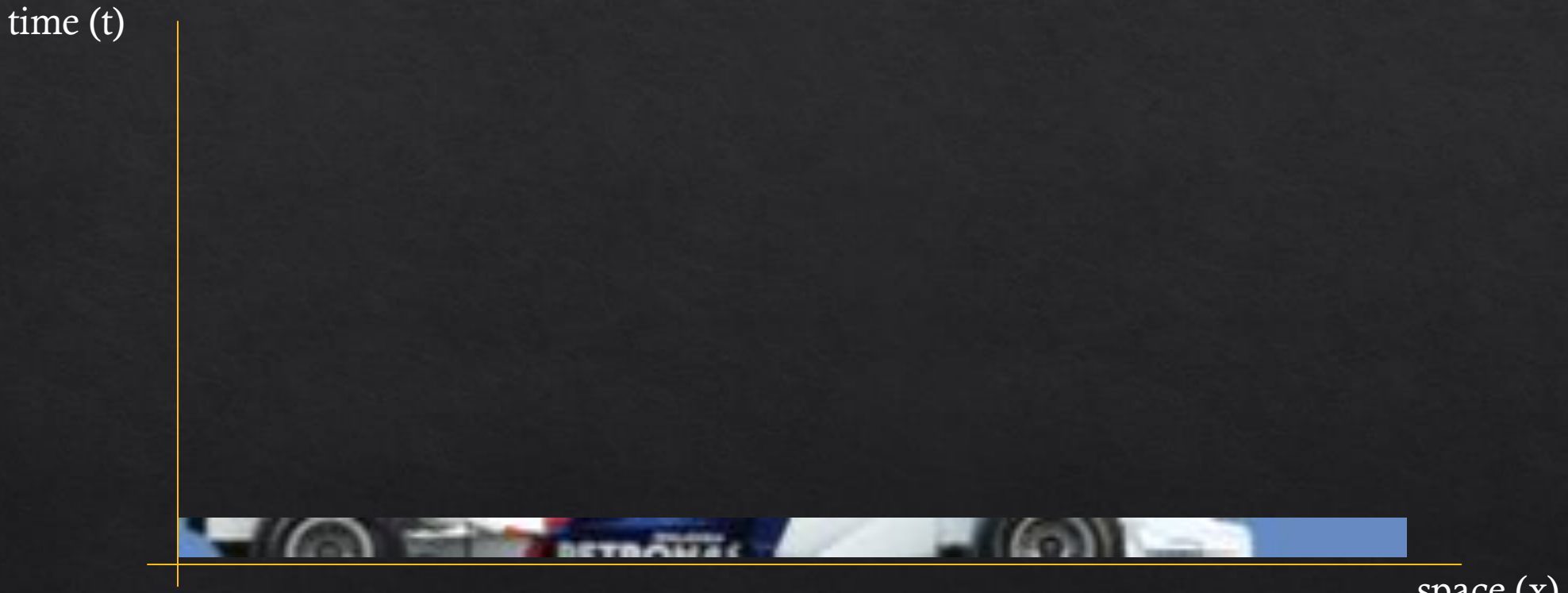
f(x)

Example: motion blur

Example: slice is a 1D function

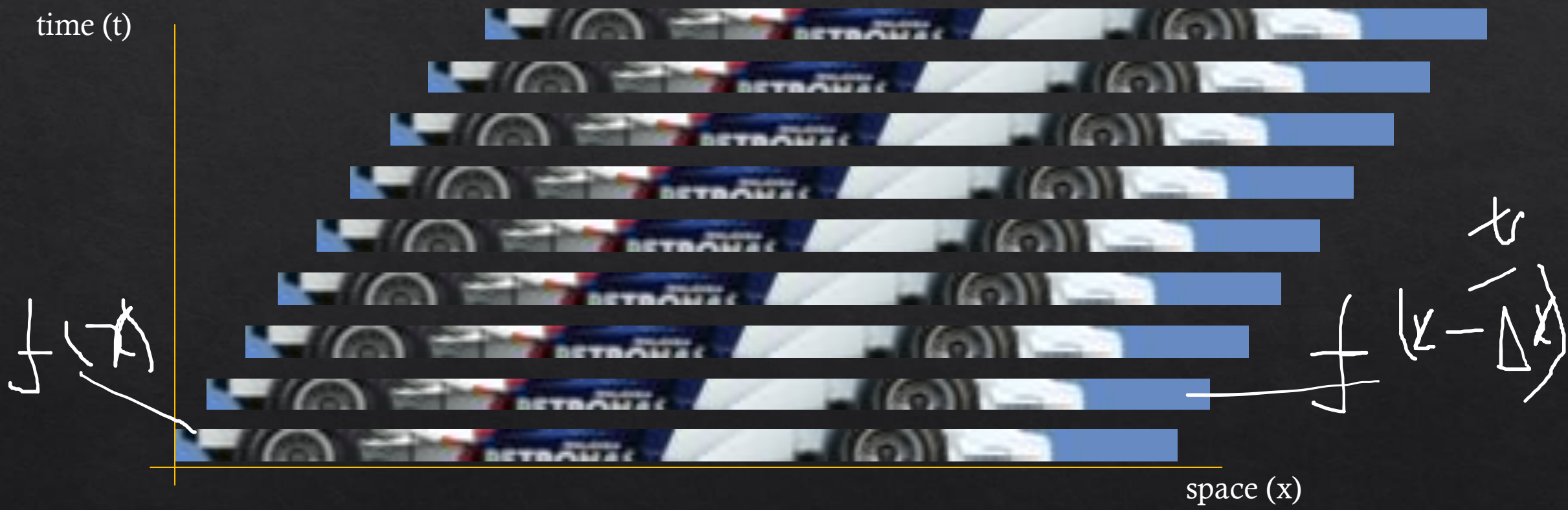


Example: add time as second dimension

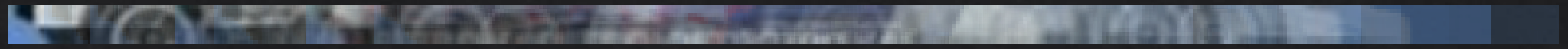


Example: stationary car

Example: car moving to the right



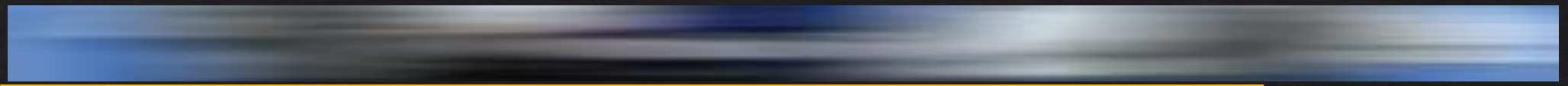
Example: sum of shifted positions



space (x)

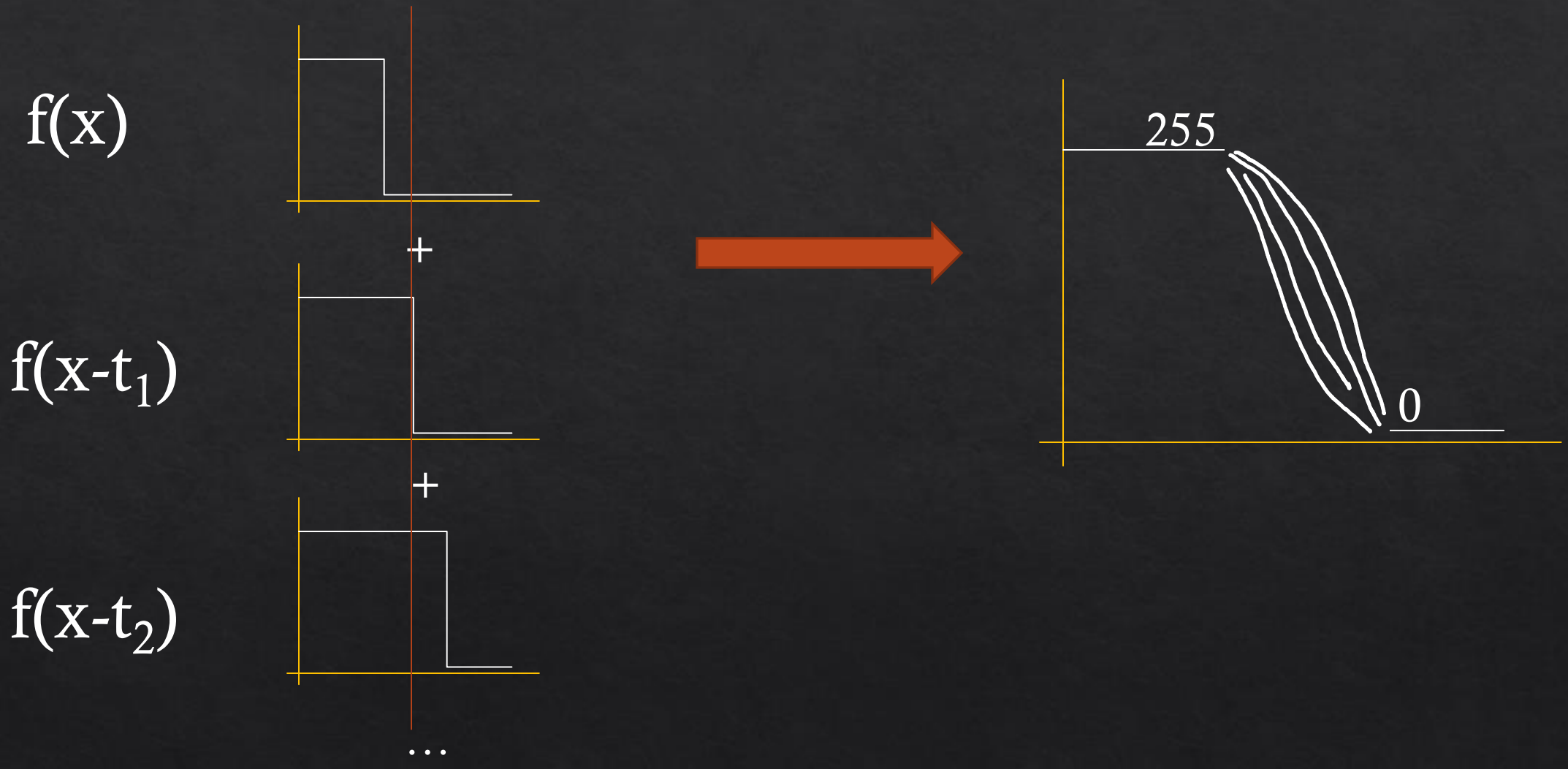
Example: motion blur

$$\int f(x-t)\,dt$$



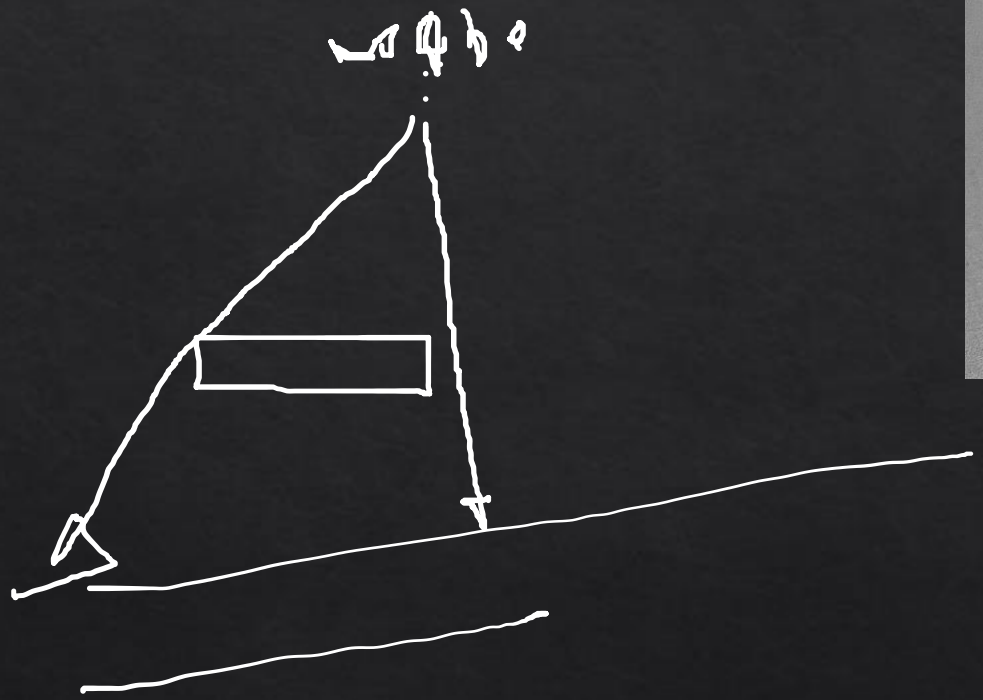
space (x)

Sums of shifted functions!

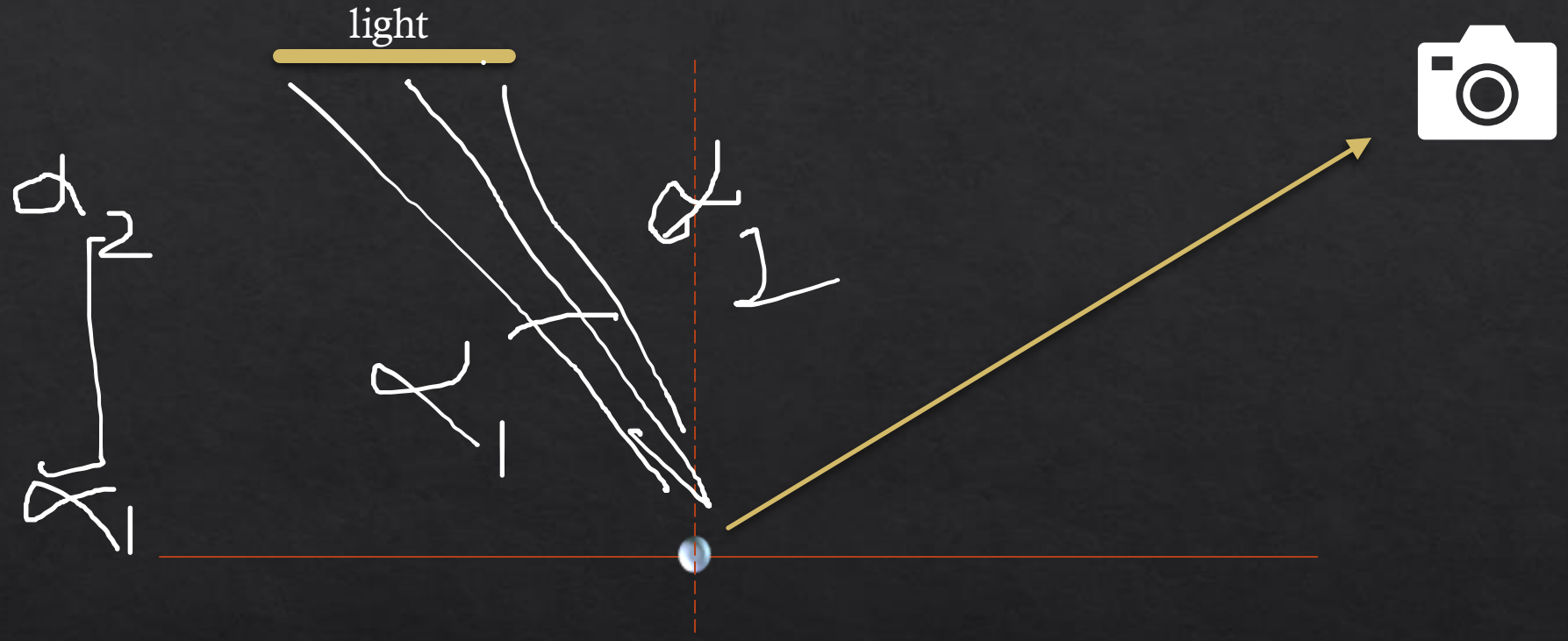


Can you spot the “shifted sums” in each case?

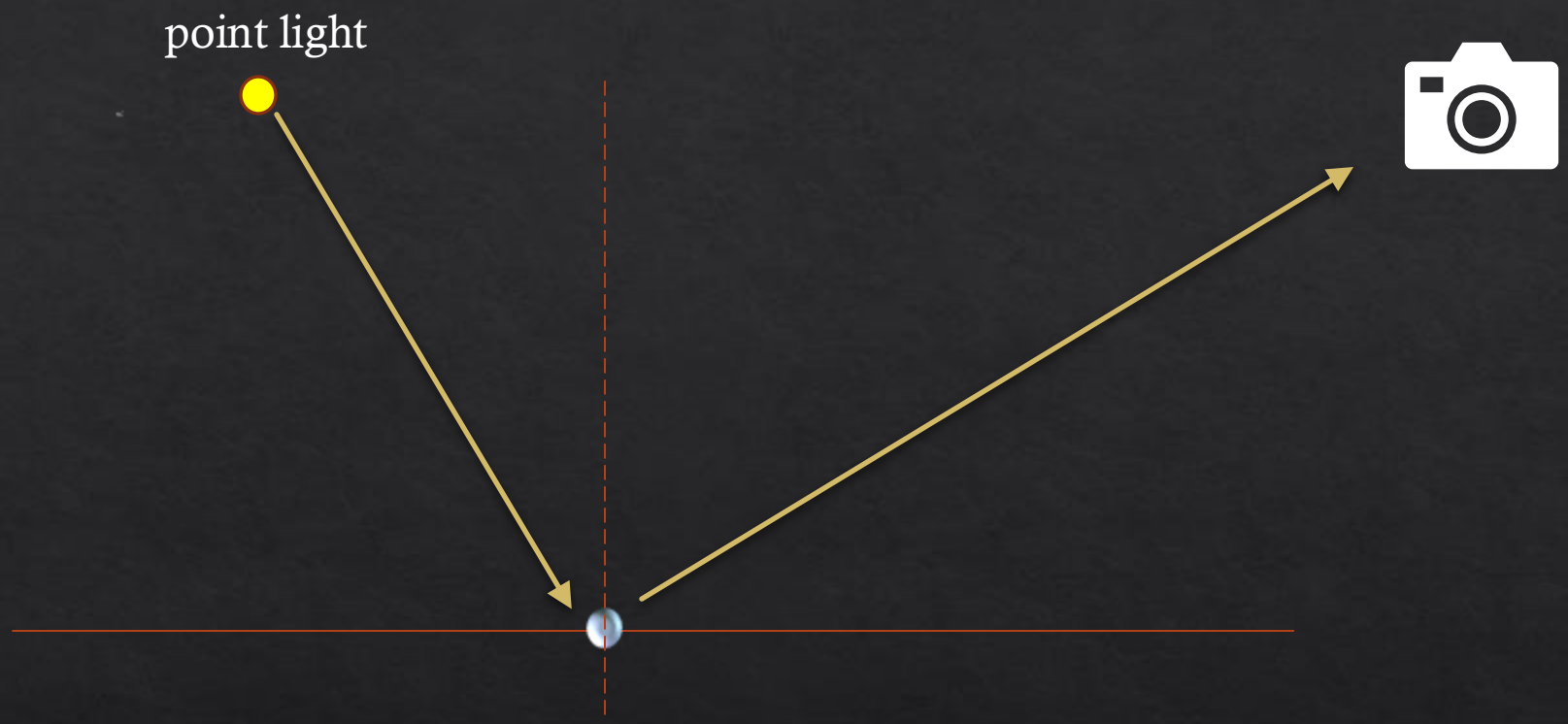
Soft shadow due to area light



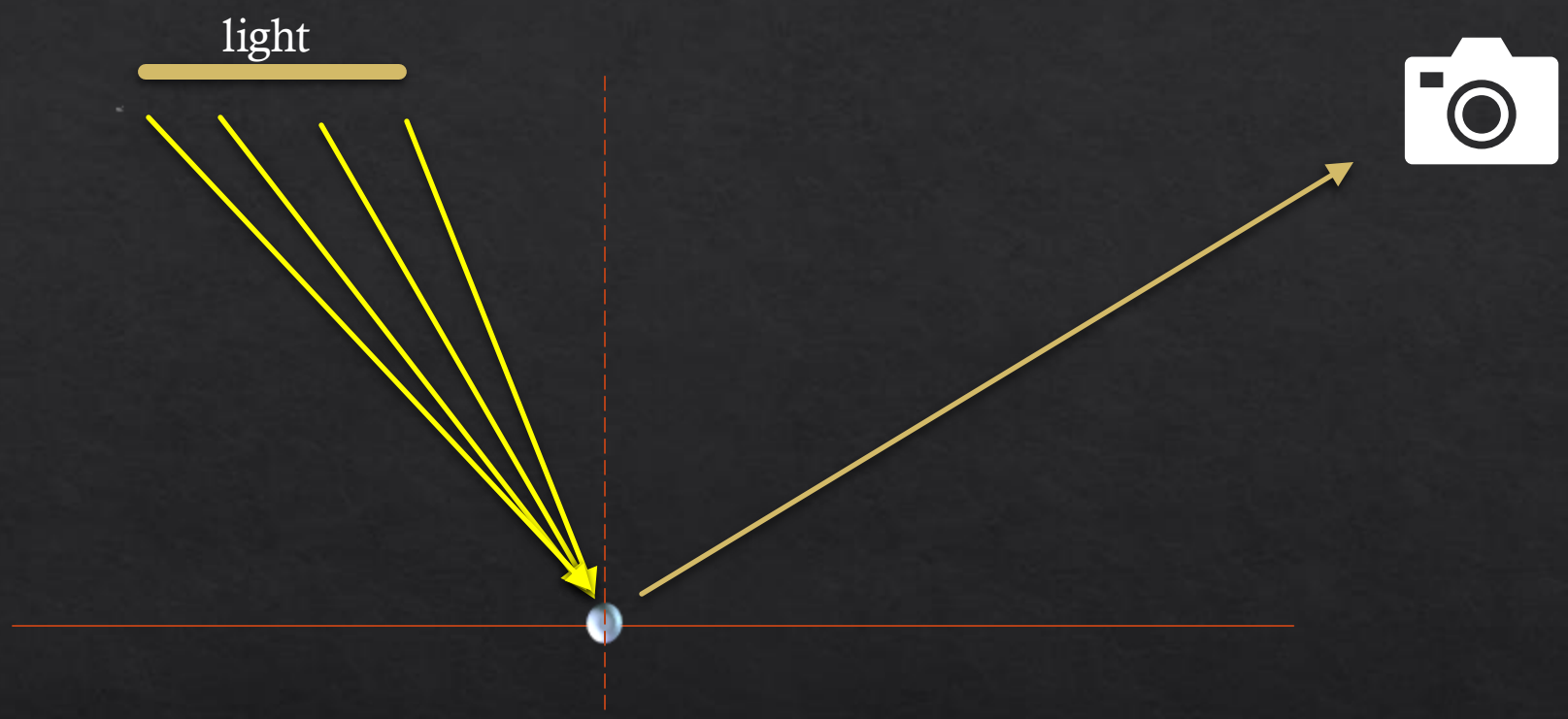
Example: Area light



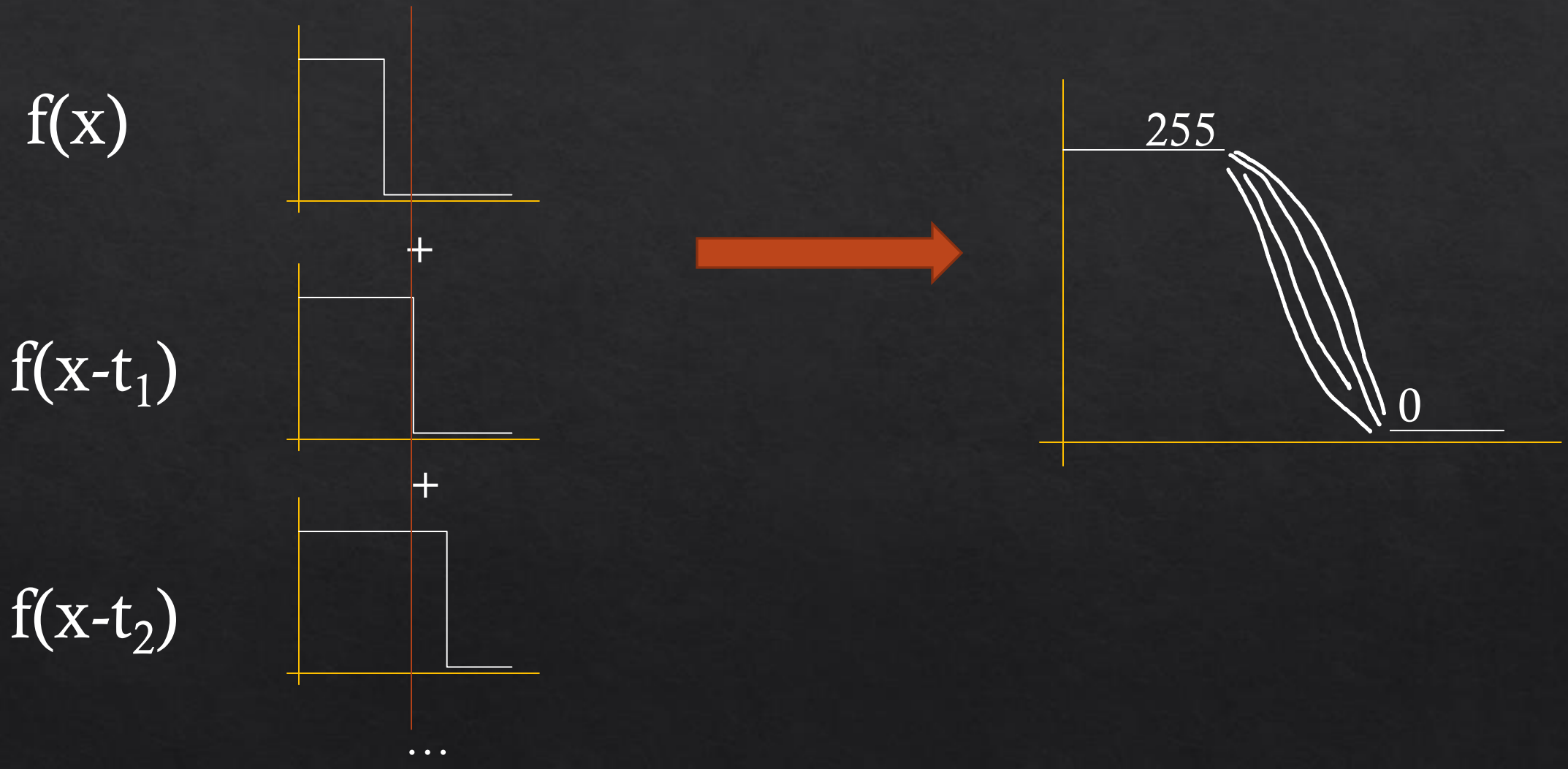
Example: Area light



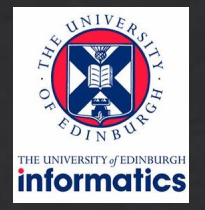
Area light: integrate over angle



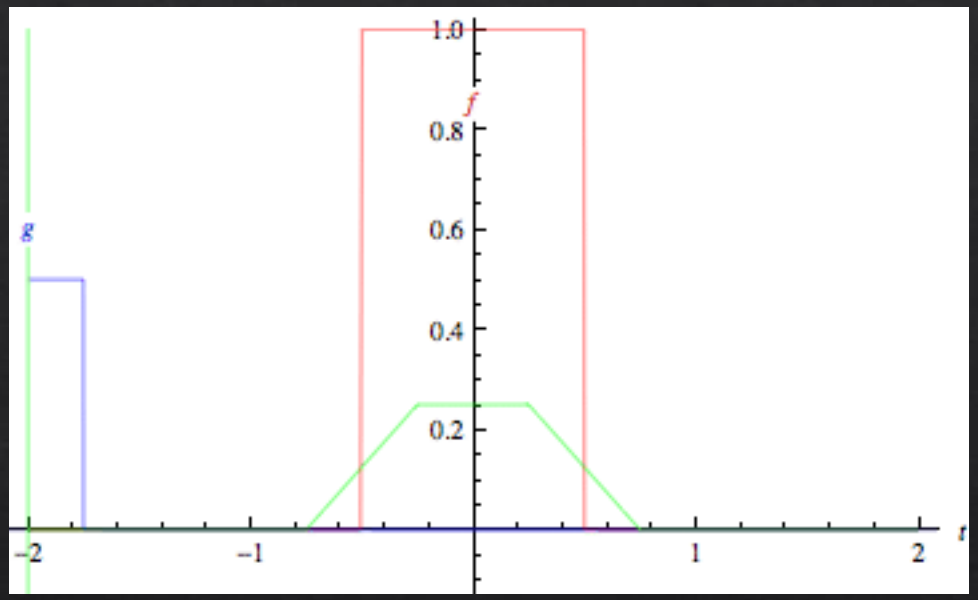
Sums of shifted functions!



Sums of weighted, shifted functions!

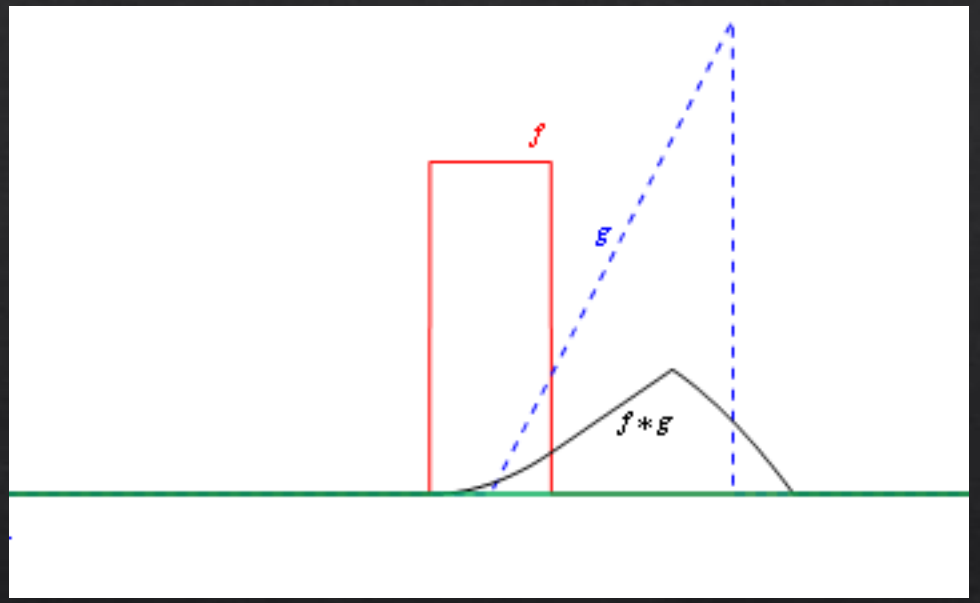


Sums of weighted, shifted functions!

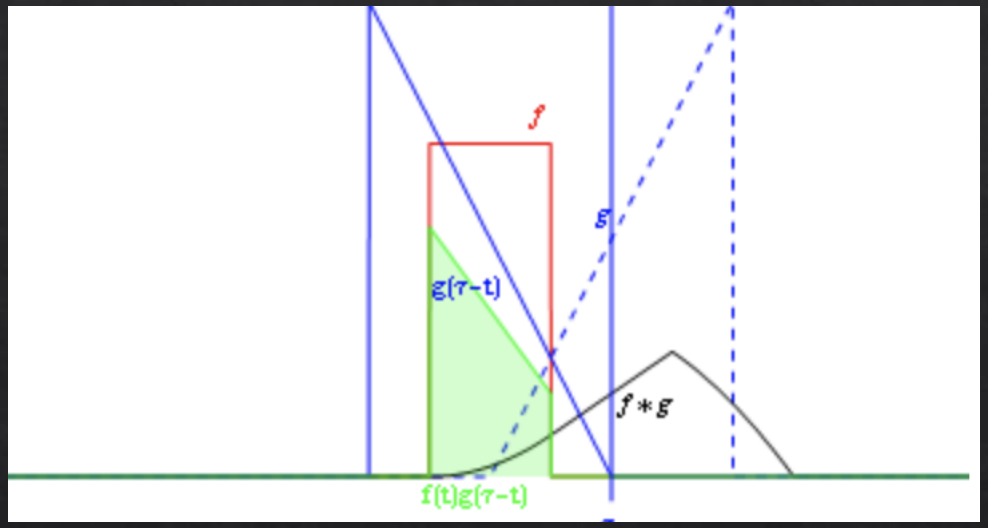


wikipedia

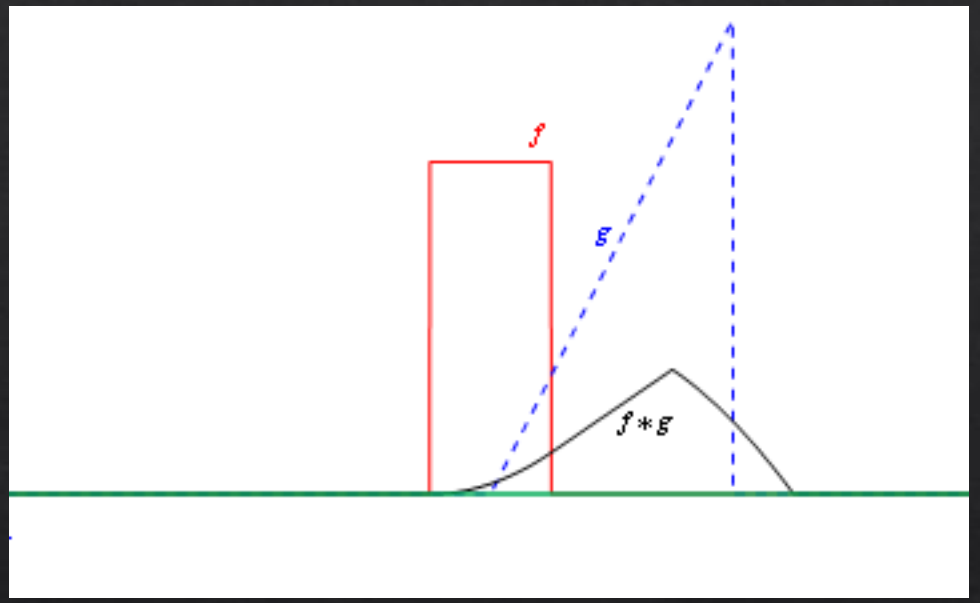
Sums of weighted, shifted functions!



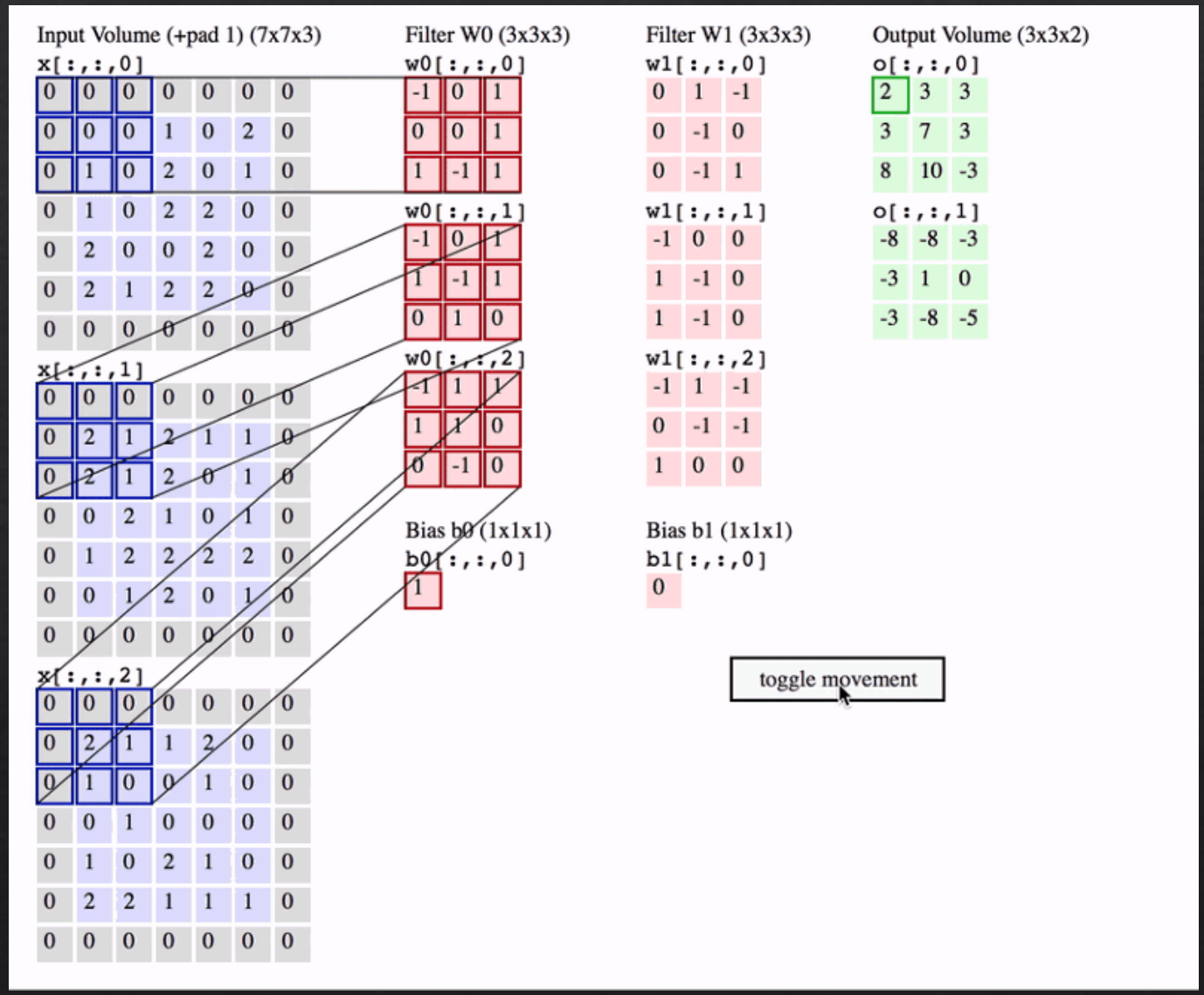
1D convolution



Sums of weighted, shifted functions!



2D convolution



https://www.freecodecamp.org/news/an-intuitive-guide-to-convolutional-neural-networks-260c2de0a050/

Blurring due to integrals in rendering

- area lights
- camera lens
- camera shutter, exposure time
- wavelength (colour spectrum)
- gloss (reflectance)
- translucent objects