COMS30020 - Computer Graphics

Week 4 Briefing

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And now, the moment you've all been waiting for...

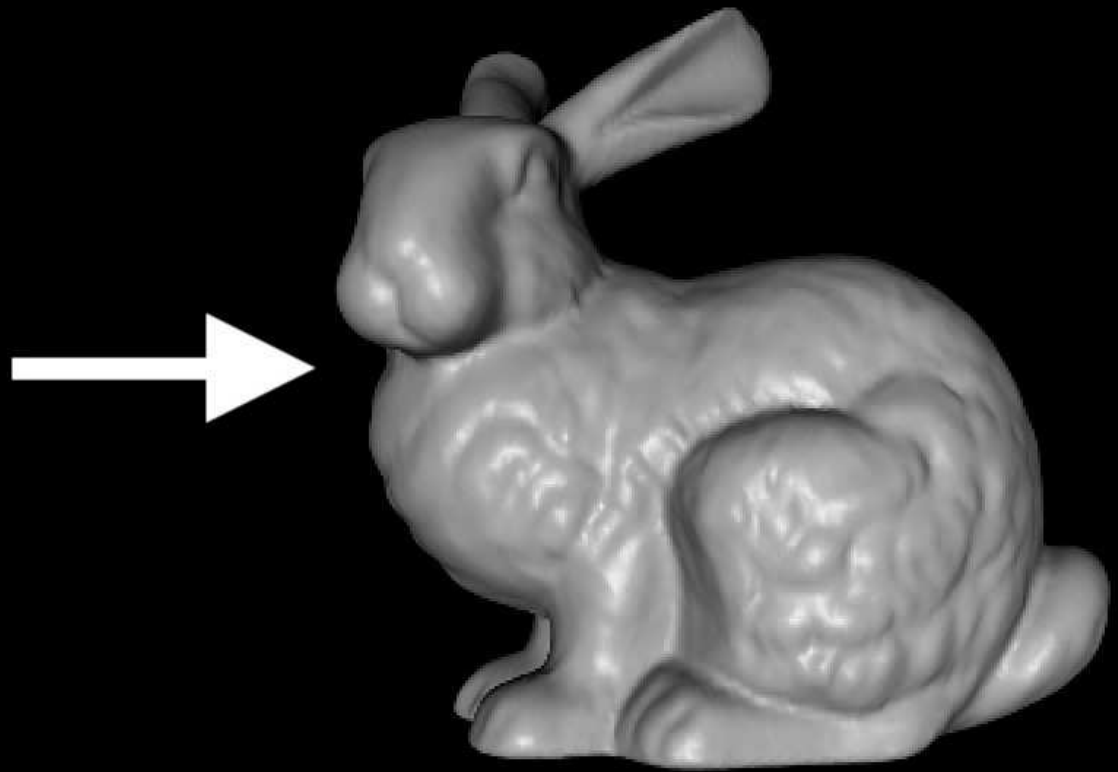
TIME TO START WORKING IN 3D !!!

2D functions you've already written will be useful !

Your Objective is Simple (to Explain ;o)

stanford-bunny.obj

```
v -0.037830 0.127940 0.004475
v -0.044779 0.128887 0.001905
v -0.068010 0.151244 0.037195
v -0.002287 0.130150 0.023220
v -0.022605 0.126675 0.007156
v -0.025108 0.125921 0.006242
v -0.037121 0.127449 0.001796
v 0.033213 0.112692 0.027686
v 0.038043 0.109755 0.016169
v -0.025508 0.112568 0.036677
v -0.024531 0.112636 0.037347
v 0.027403 0.121560 0.021221
v -0.062896 0.158419 -0.017587
v 0.040081 0.104202 0.022168
v 0.045153 0.093197 0.011160
v -0.032497 0.174231 -0.002390
```



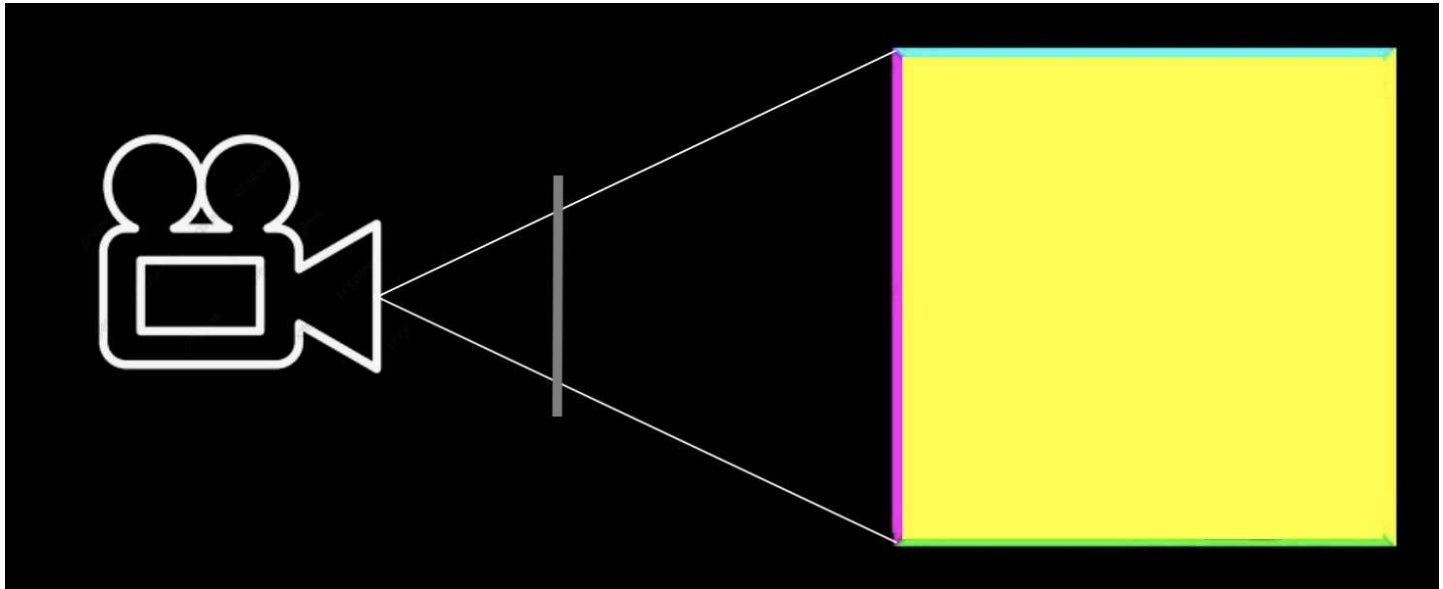
The general setup for the rest of the unit

model - a scene in three dimensional space

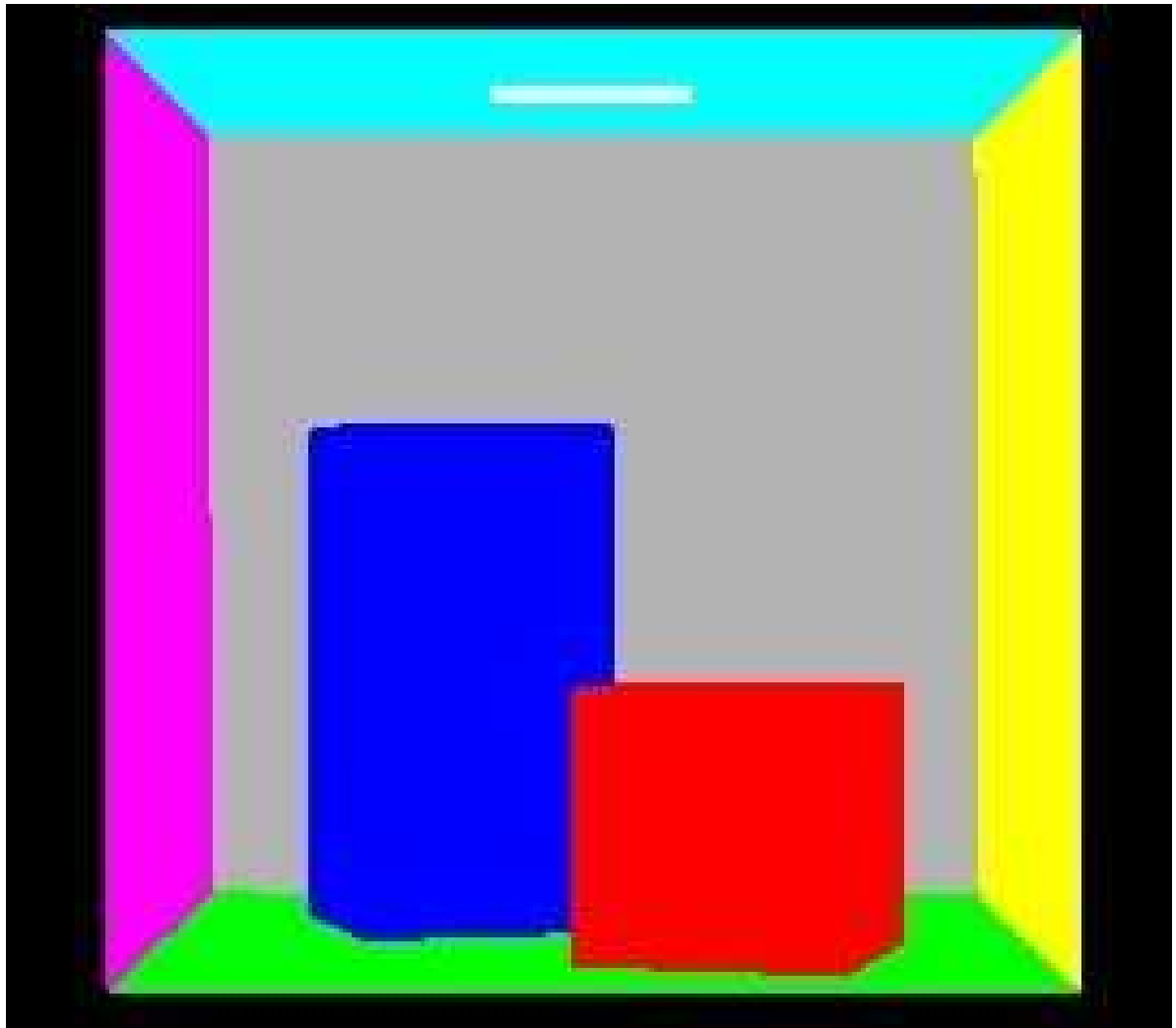
camera - our chosen viewpoint on the scene

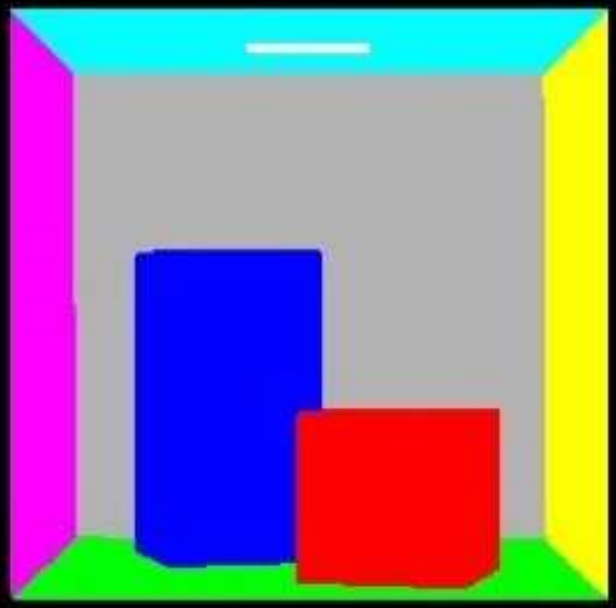
image plane - canvas onto which we draw scene

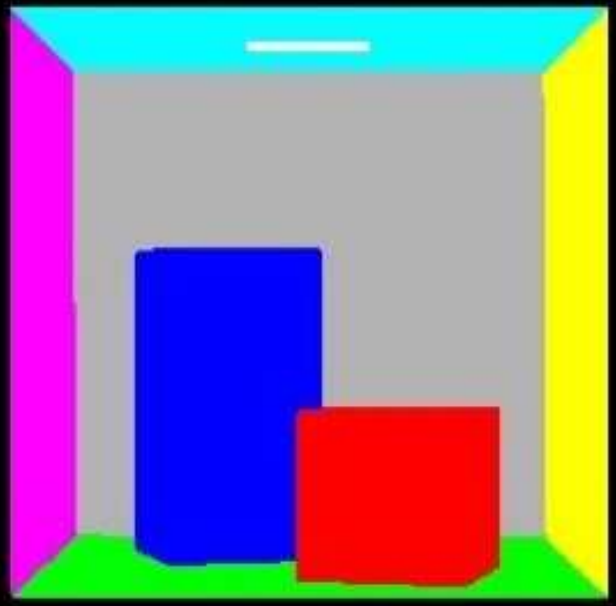
focal length - distance from camera to image plane



Your model for the next 4 weeks



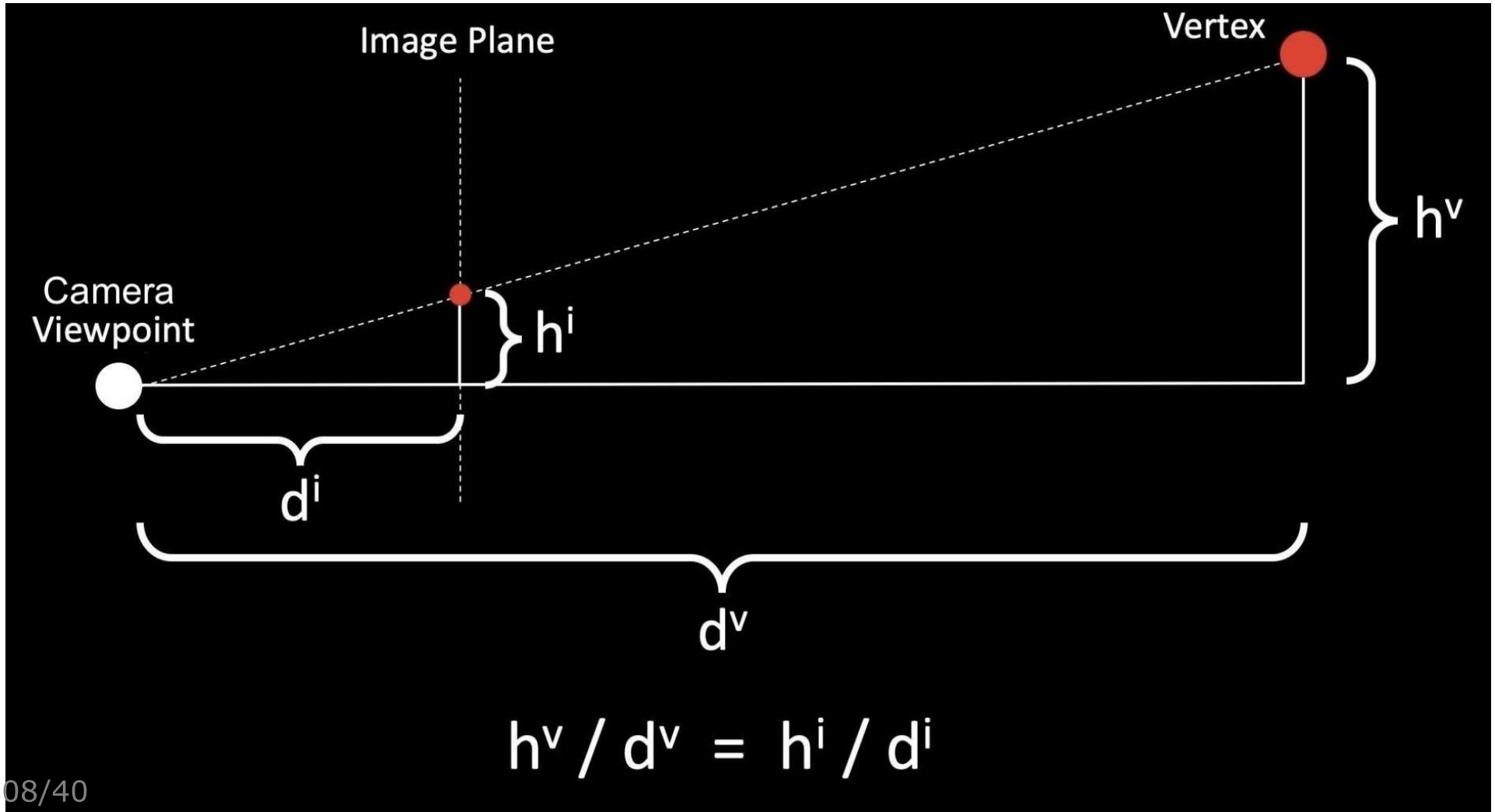




In order to render this you'll need to...

- Load in some geometry data (points in 3D space)
- Load in some colour information ('materials')
- Take a "point of view" on the model (camera pos)
- Set the position of 'image plane' ('focal length')
- Do "a bit of maths" (to 'project' vertices into 2D)
- Draw model triangles onto canvas ('image plane')

Approach is based on "Similar Triangles"

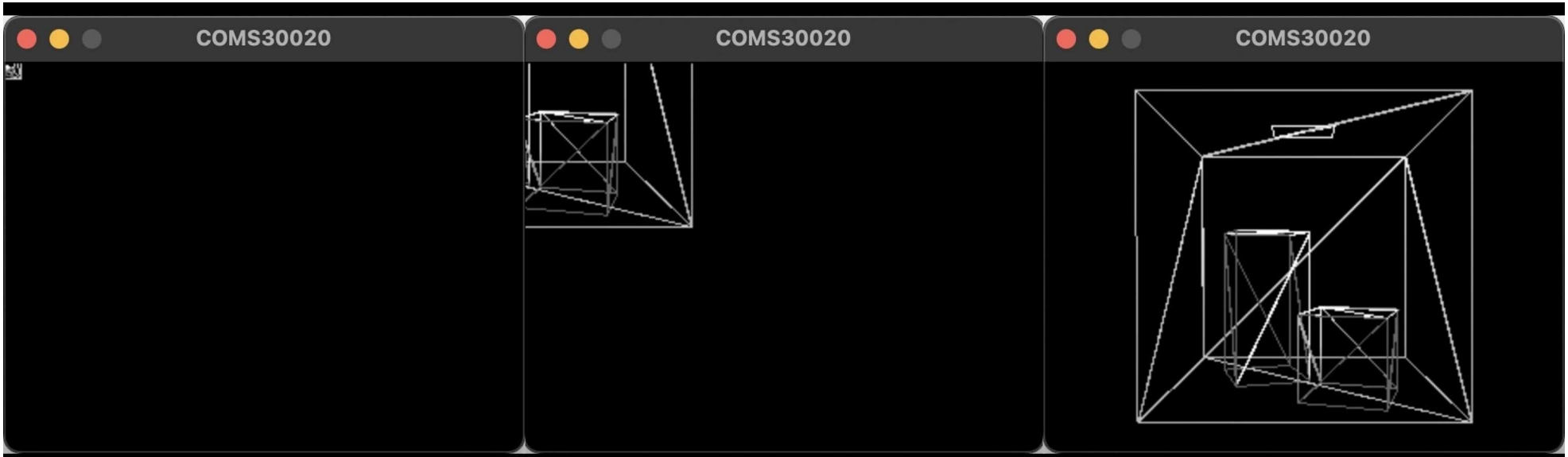


Break the problem down into steps

Don't try to implement the formulae "all in one go"

Work step-by-step, using multiple lines of code

Get each step working, before moving on to the next



Identical Rendering ?

From this point on, achieving results *identical* to samples shown in workbooks becomes much harder

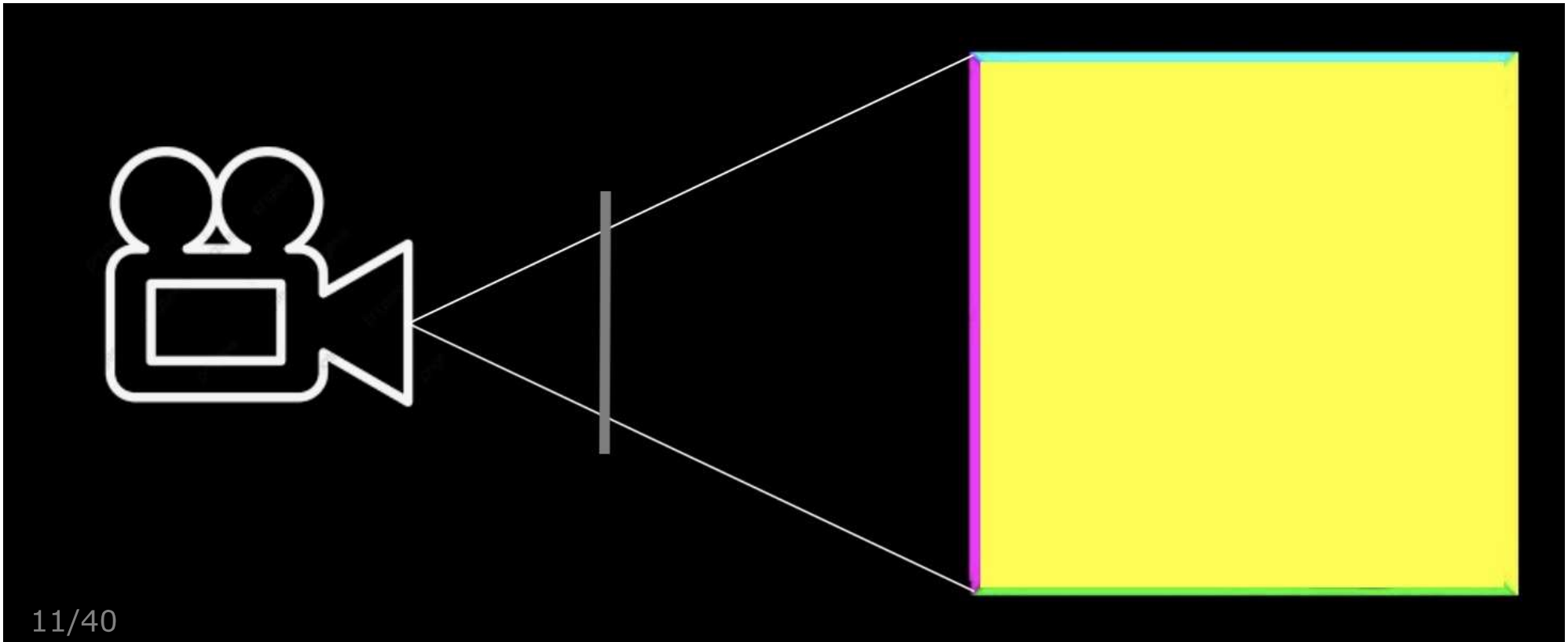
This is because the render you produce of a scene
Will depend on parameters you use in your renderer:

- Model scaling (when you load in vertices)
- Model position (relative to world origin)
- Camera position (relative to world origin)
- Image plane position ("focal length")
- Image plane scaling (used to fill the window)

Let's take a look at some of the variations...

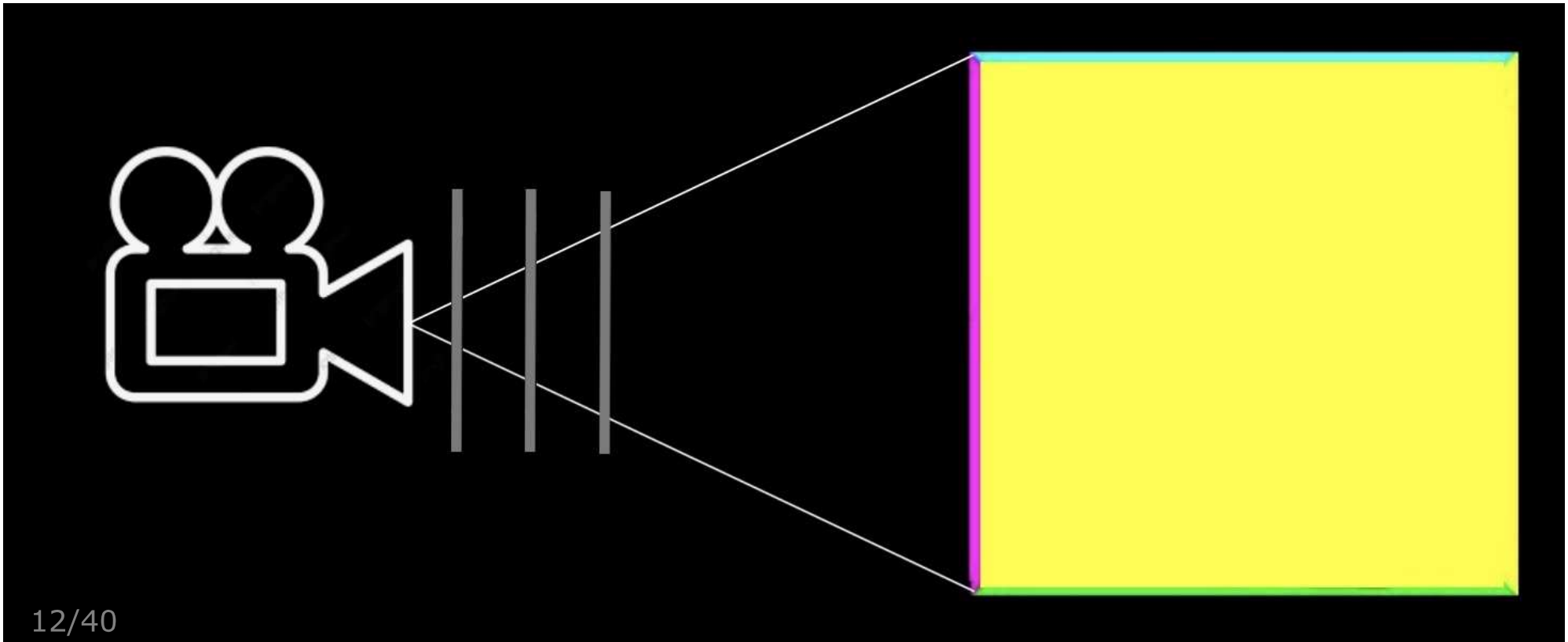
Sight lines help us imagine how a render will appear

What if we move just the position of the image plane ?

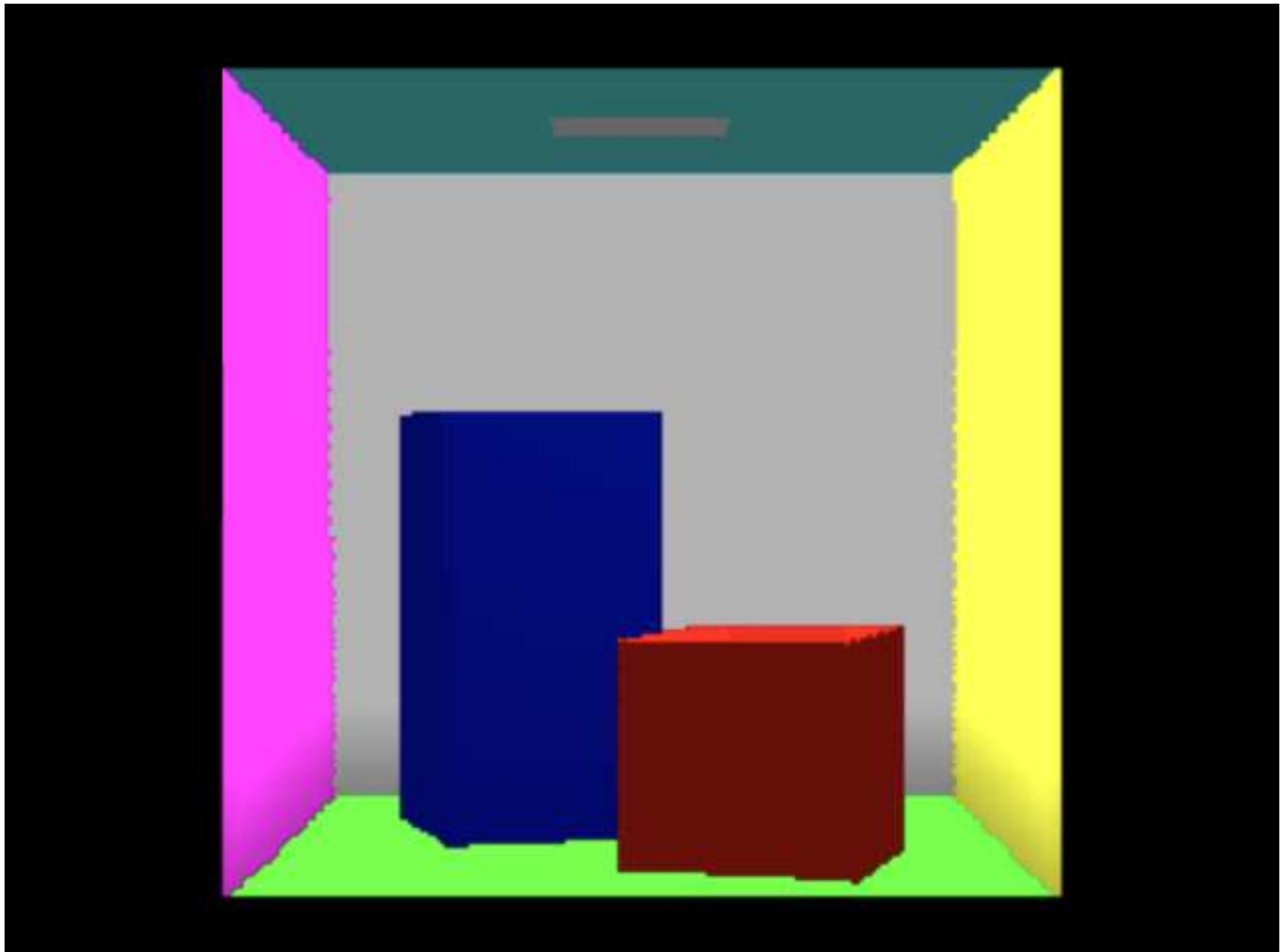


Our perspective (sight lines) on the scene stay same

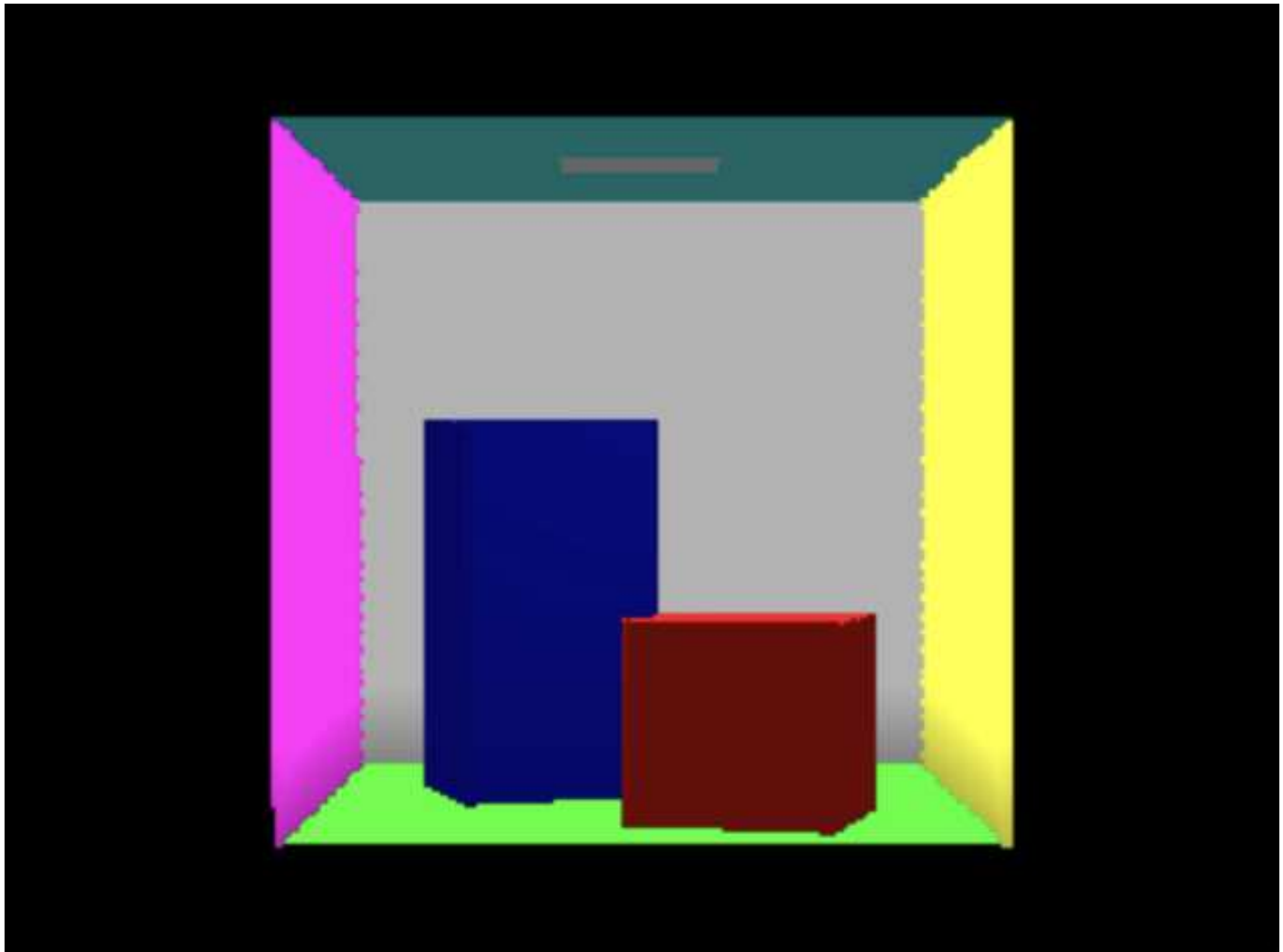
However, the size of image on image plane will change



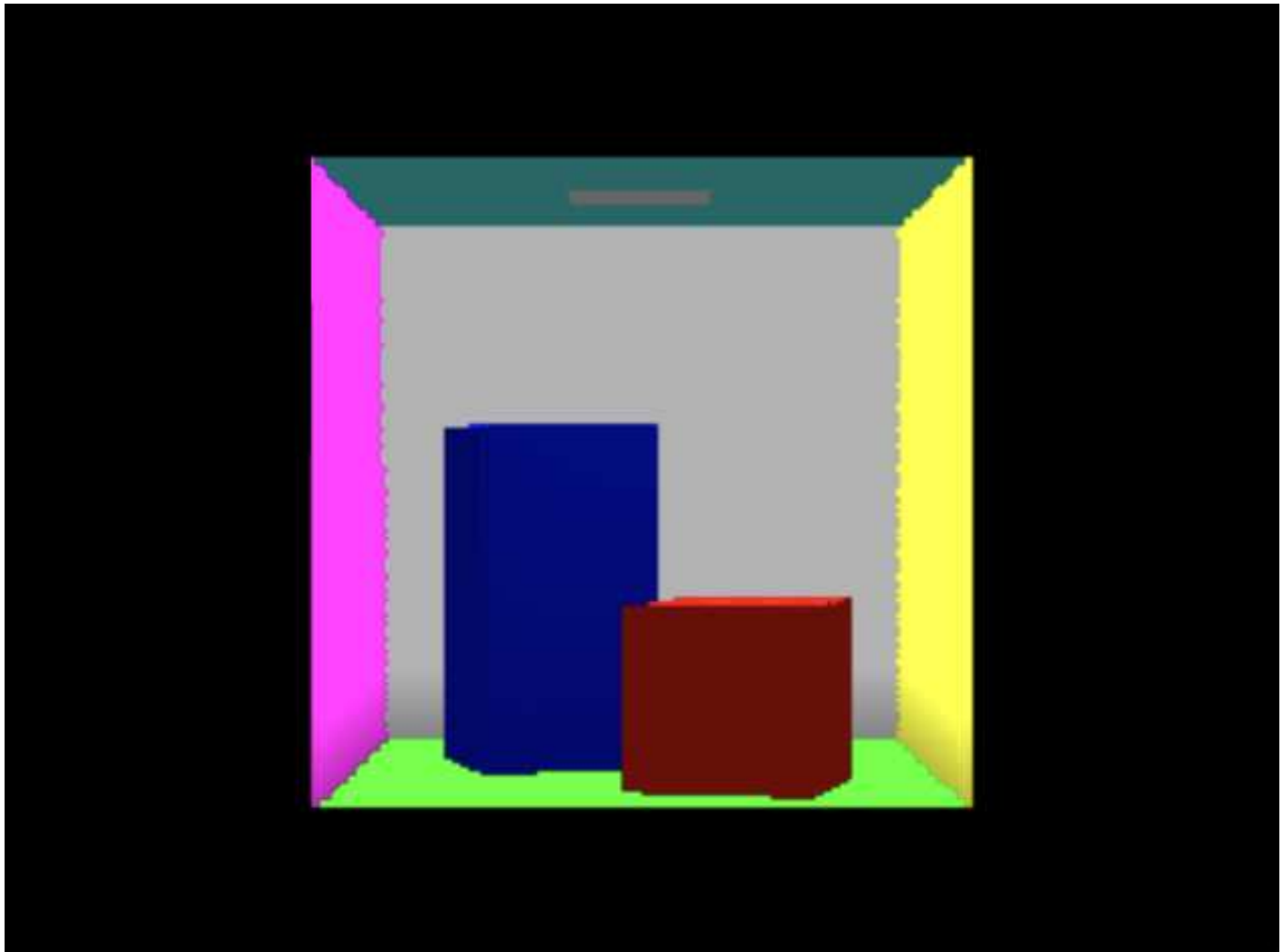
Focal Length of 4



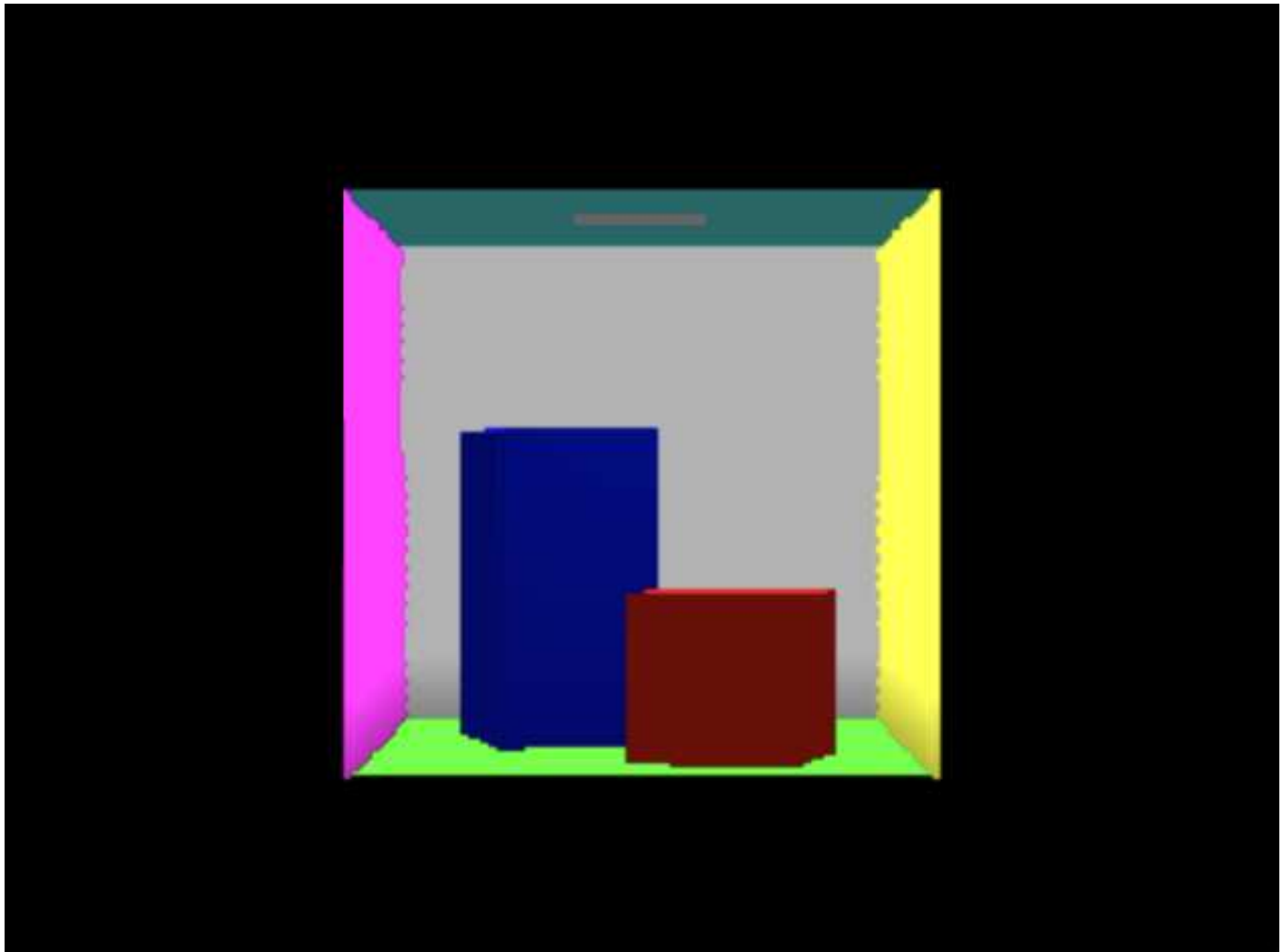
Focal Length of 3



Focal Length of 2

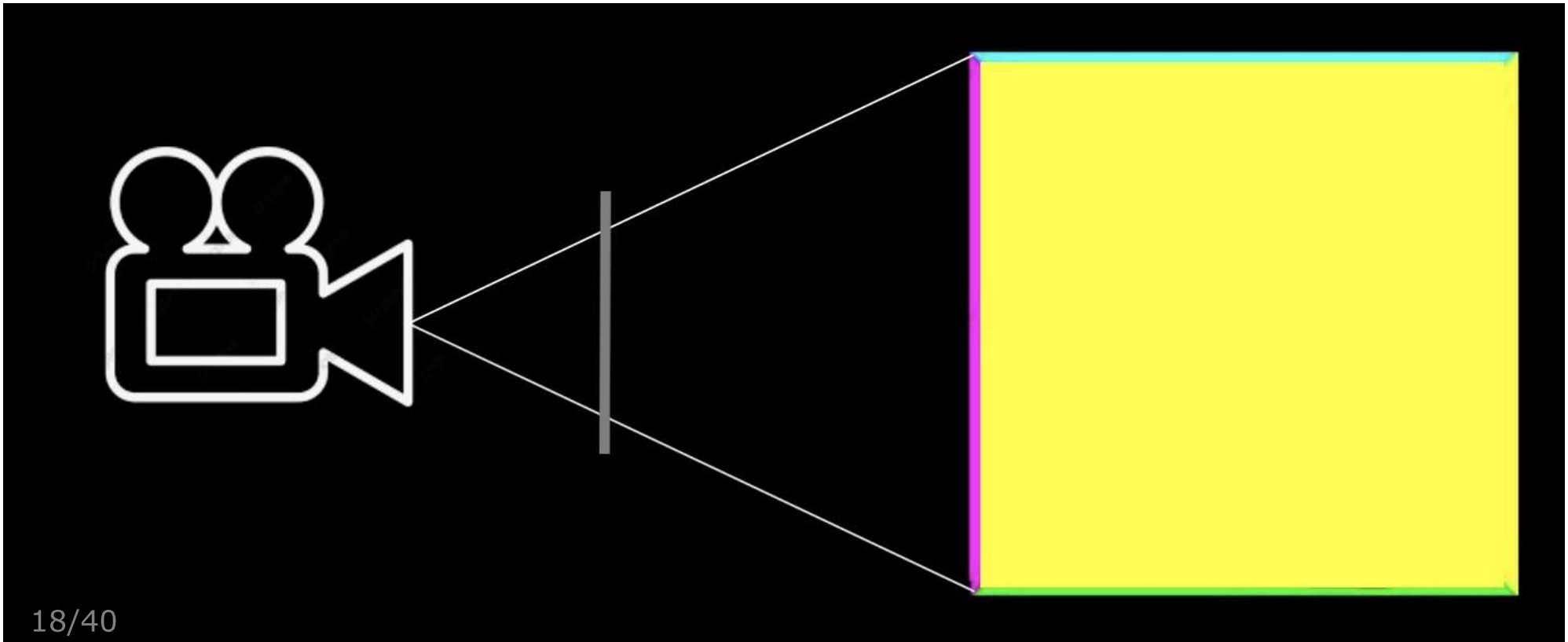


Focal Length of 1



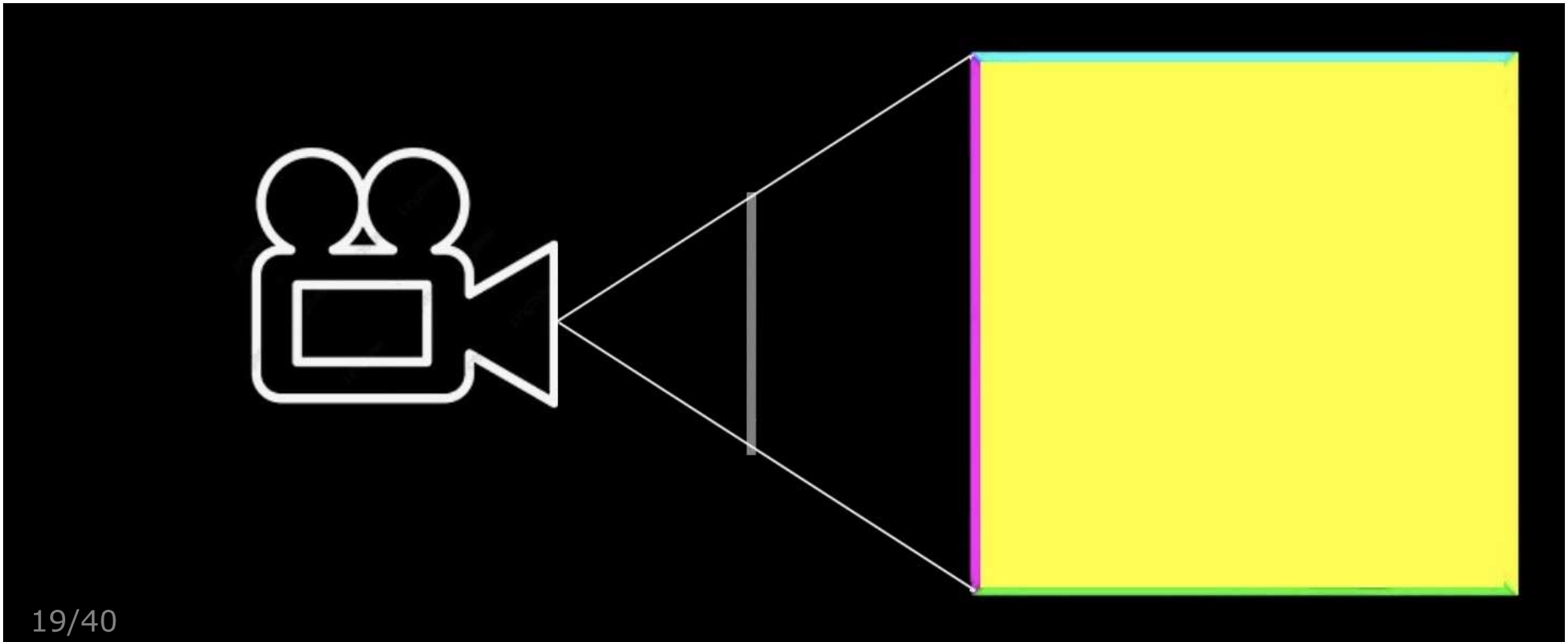
Now what if we move the POSITION of the camera ?

(without changing the focal length)

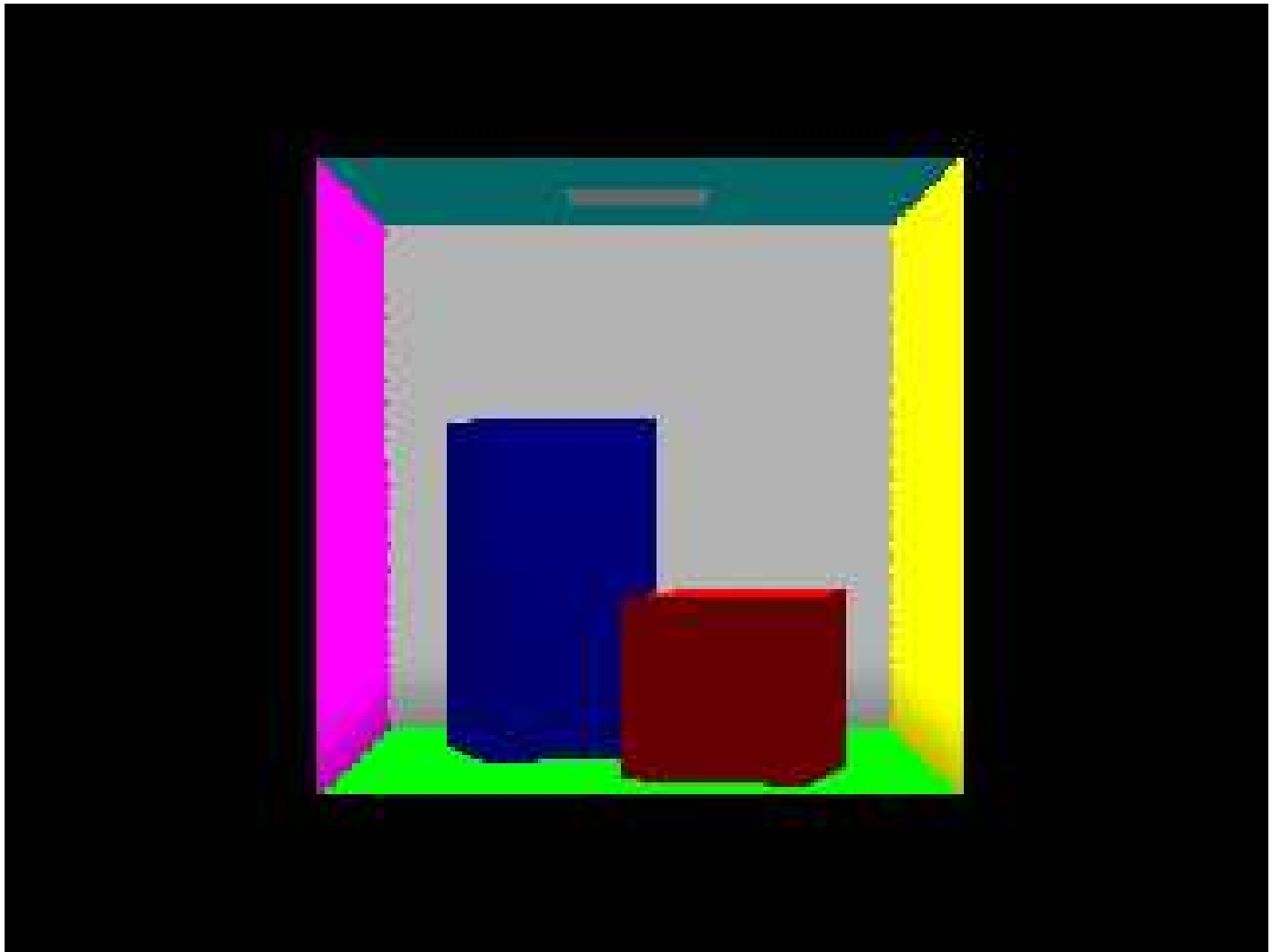


Again, the size of image on image plane will change

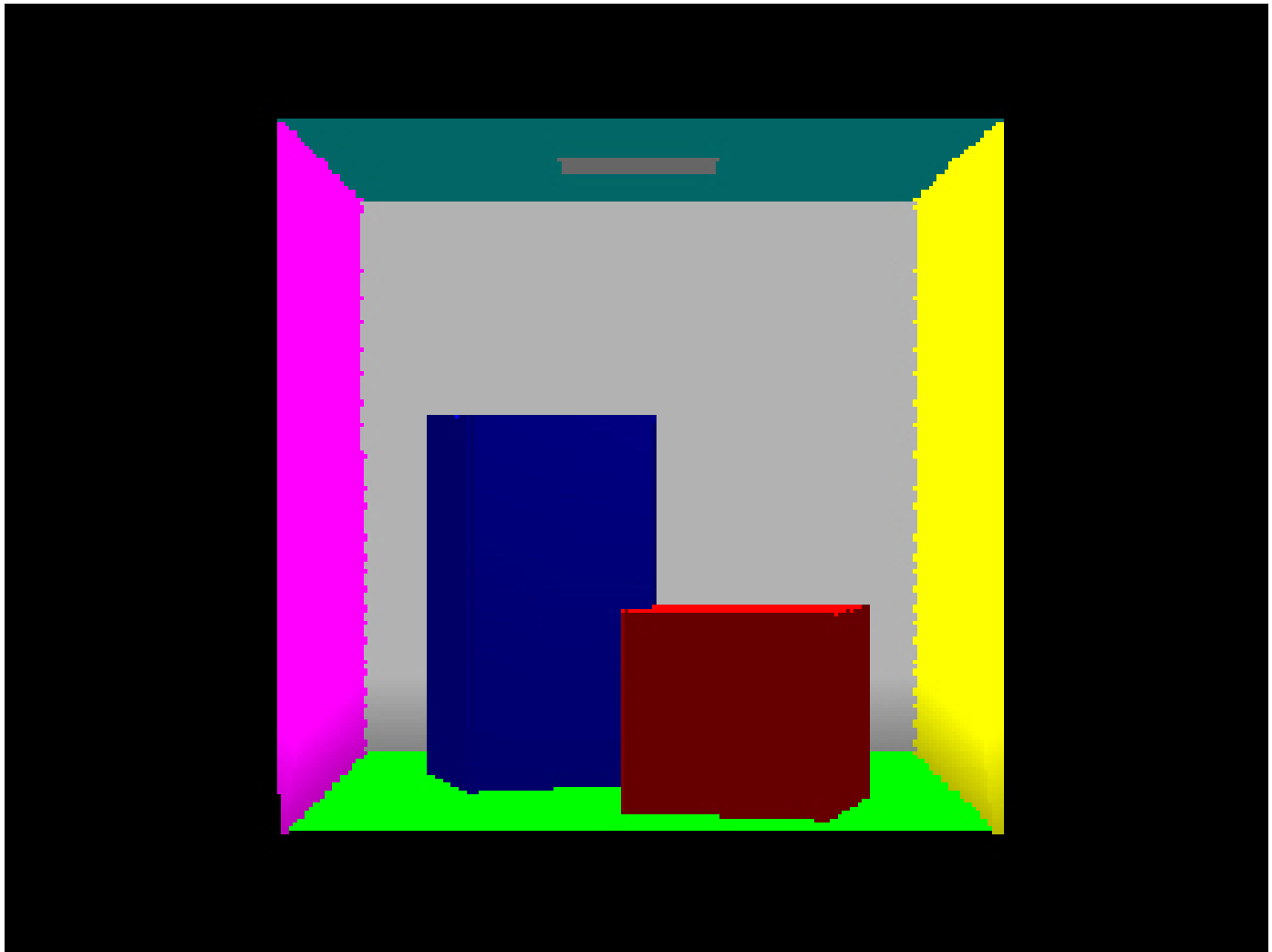
But ALSO so will our *perspective* on the scene !



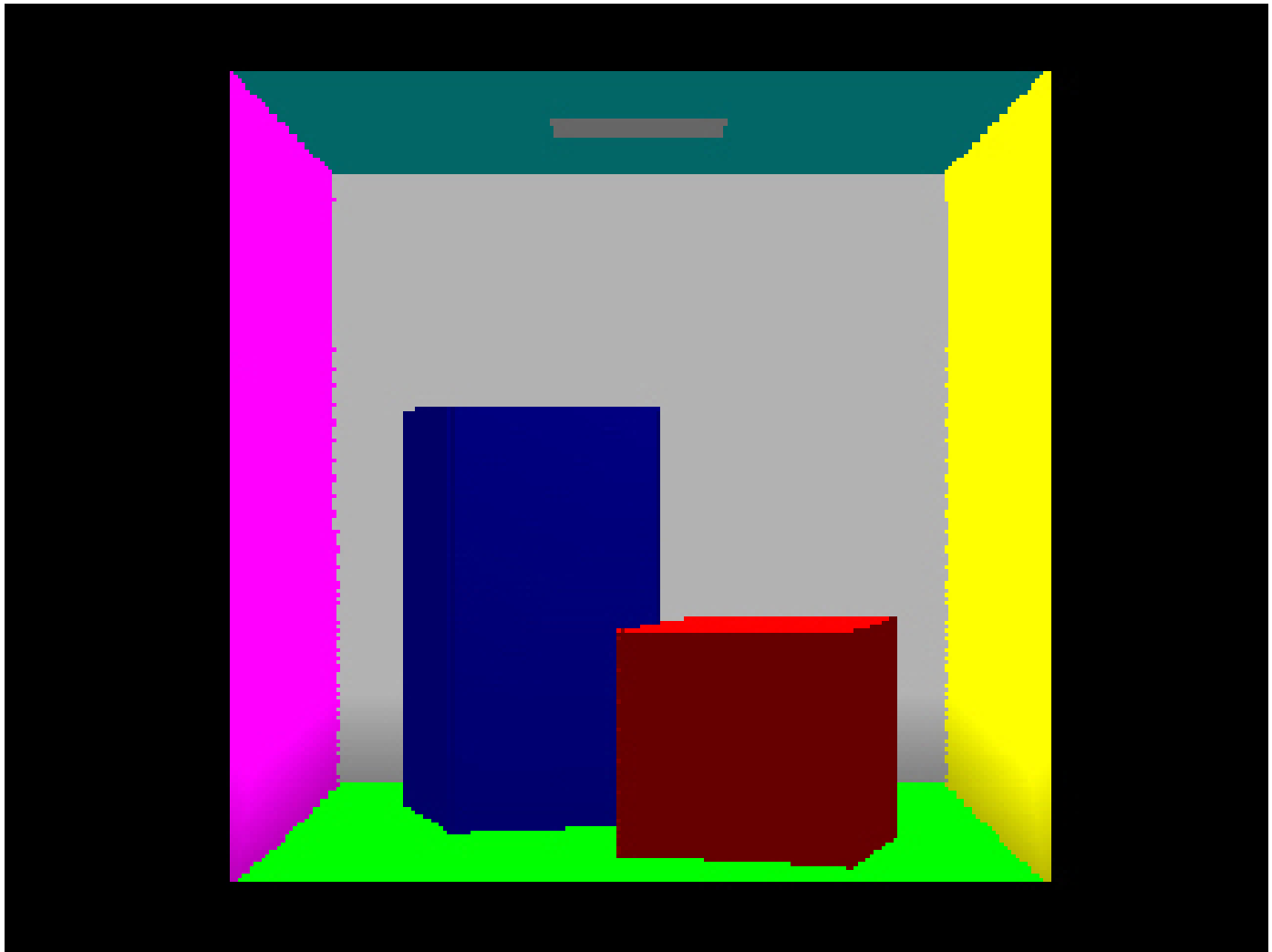
Camera Position #1



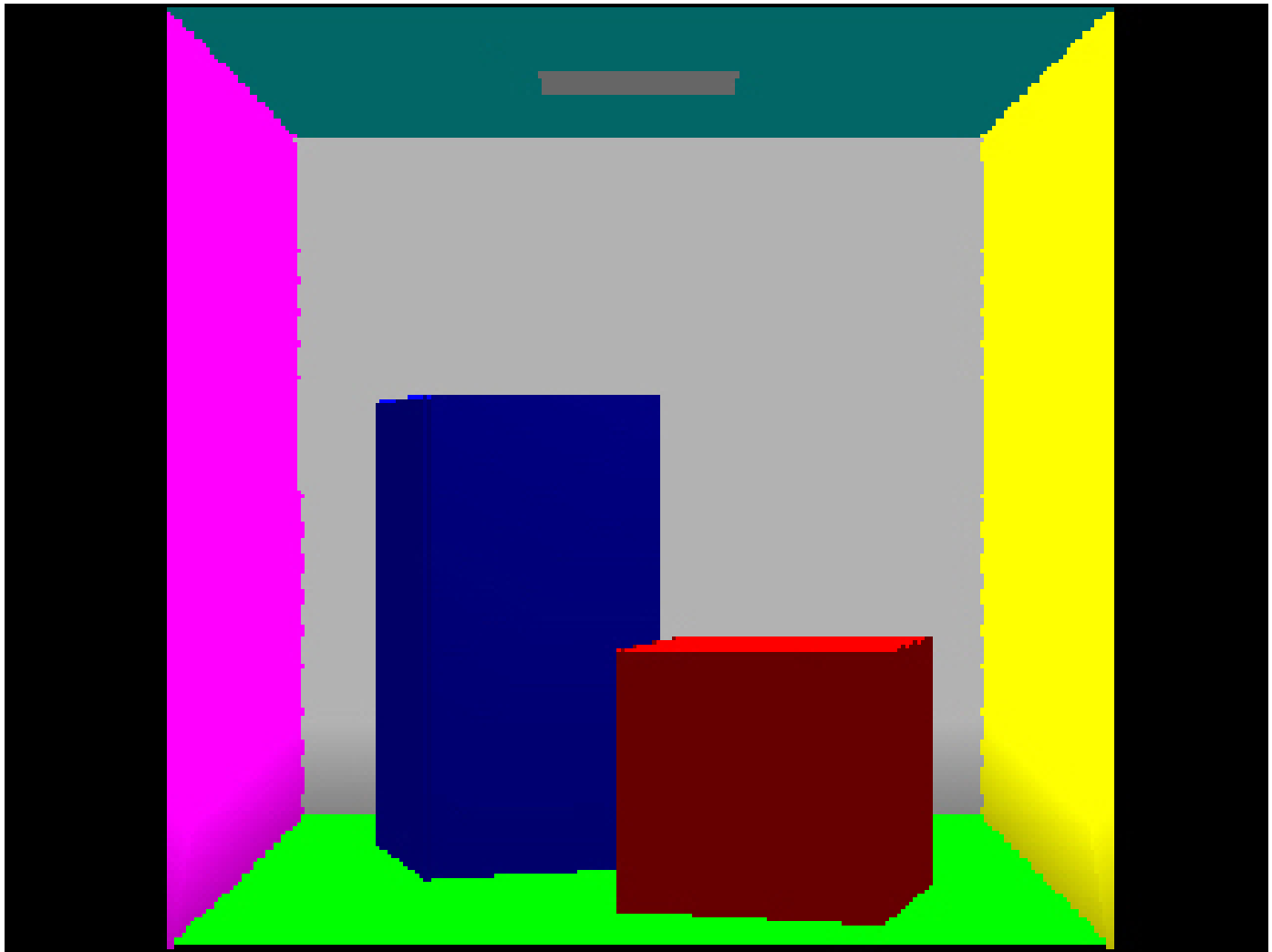
Camera Position #2



Camera Position #3



Camera Position #4



The change in perspective is hard to see

Because the size of the render is changing

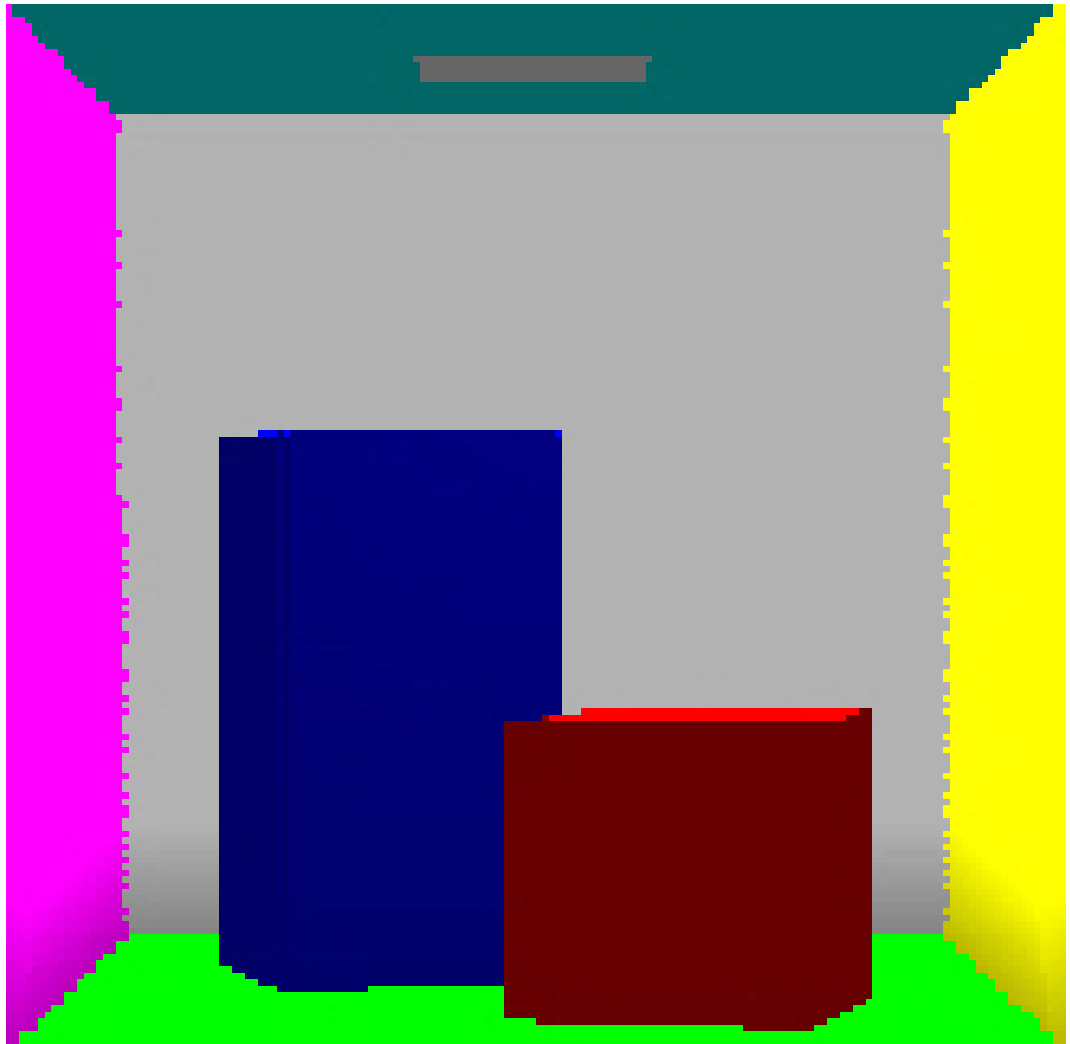
however...

If we do BOTH at the same time
(Move camera position AND shift the image plane)

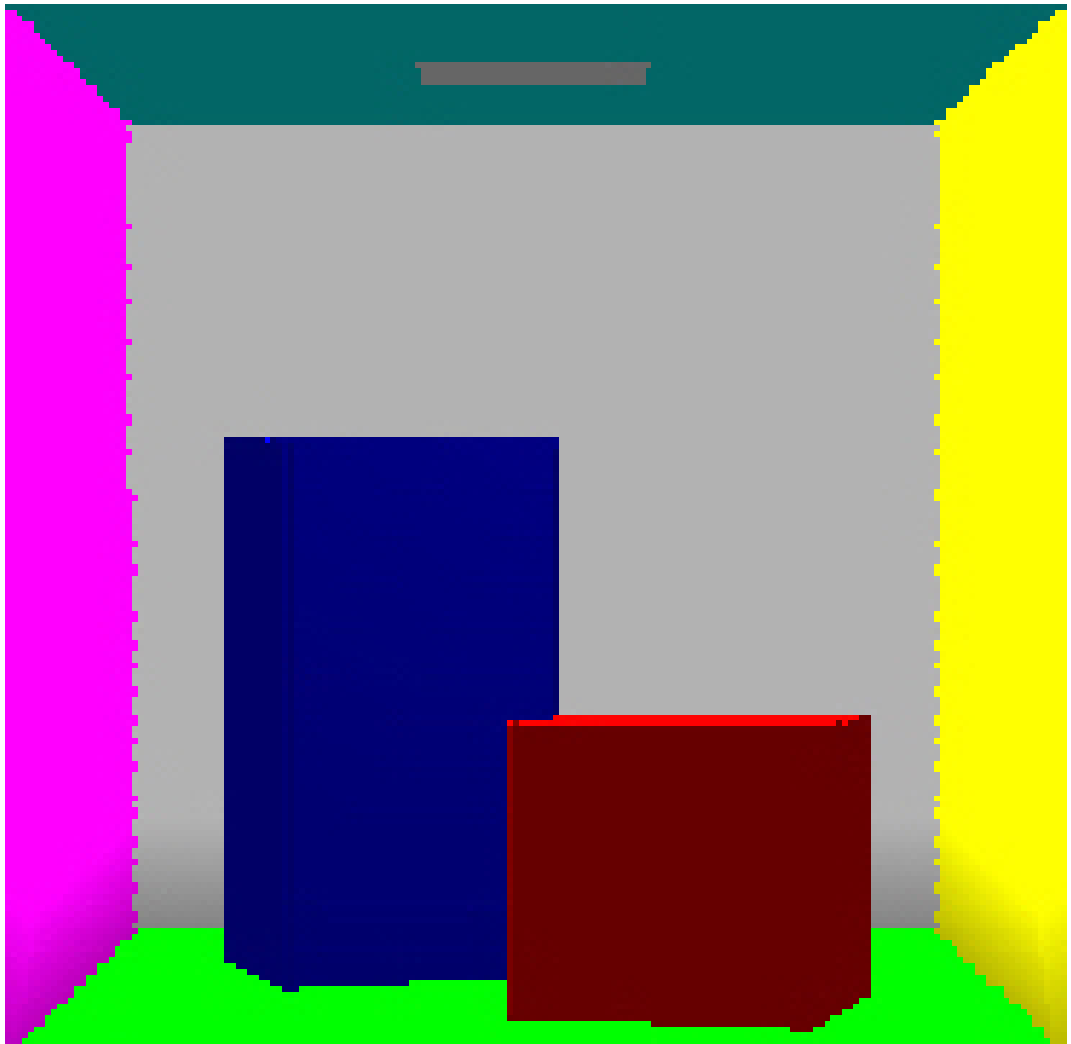
We can CANCEL OUT the two zoom effects
(if we move/shift by appropriate distances !)

This will leave us with JUST the change in perspective...

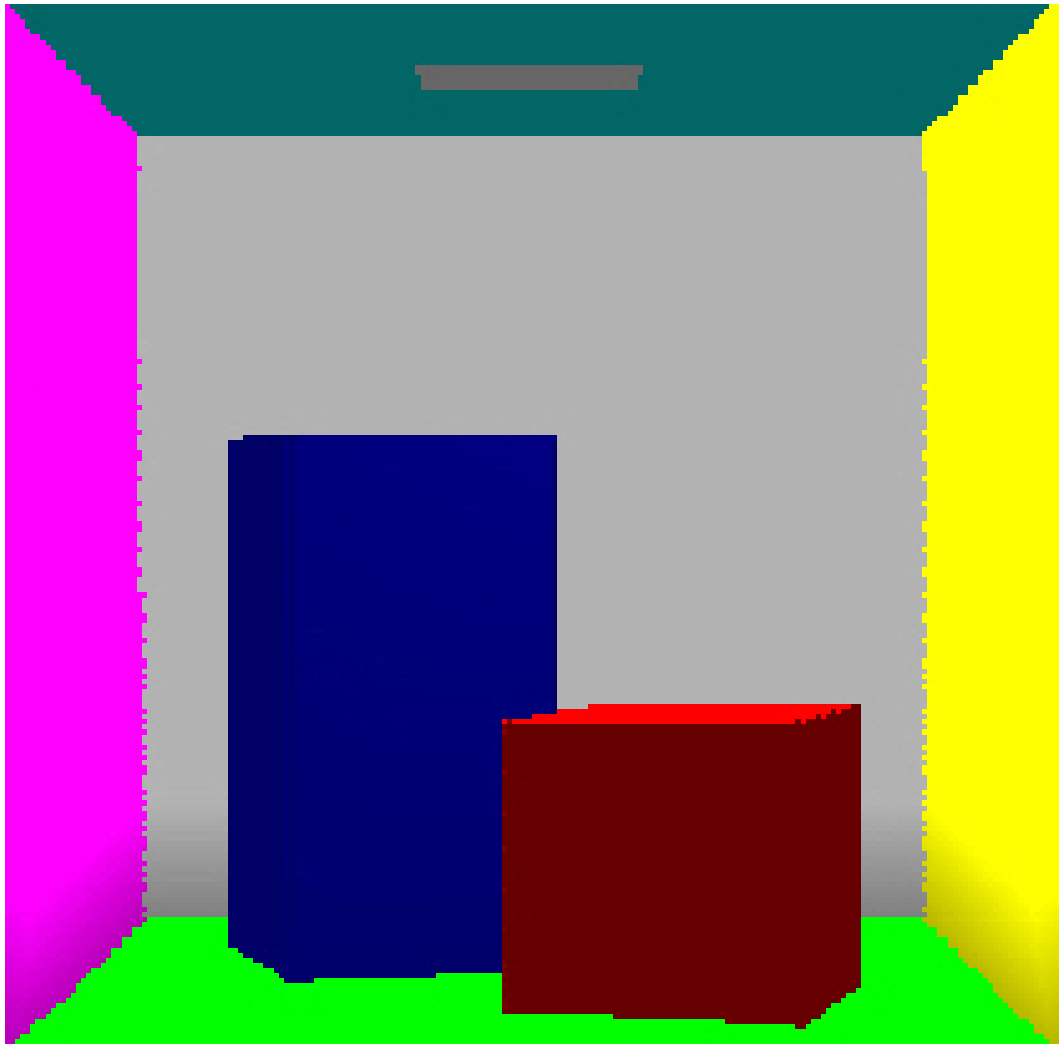
Change in perspective 1



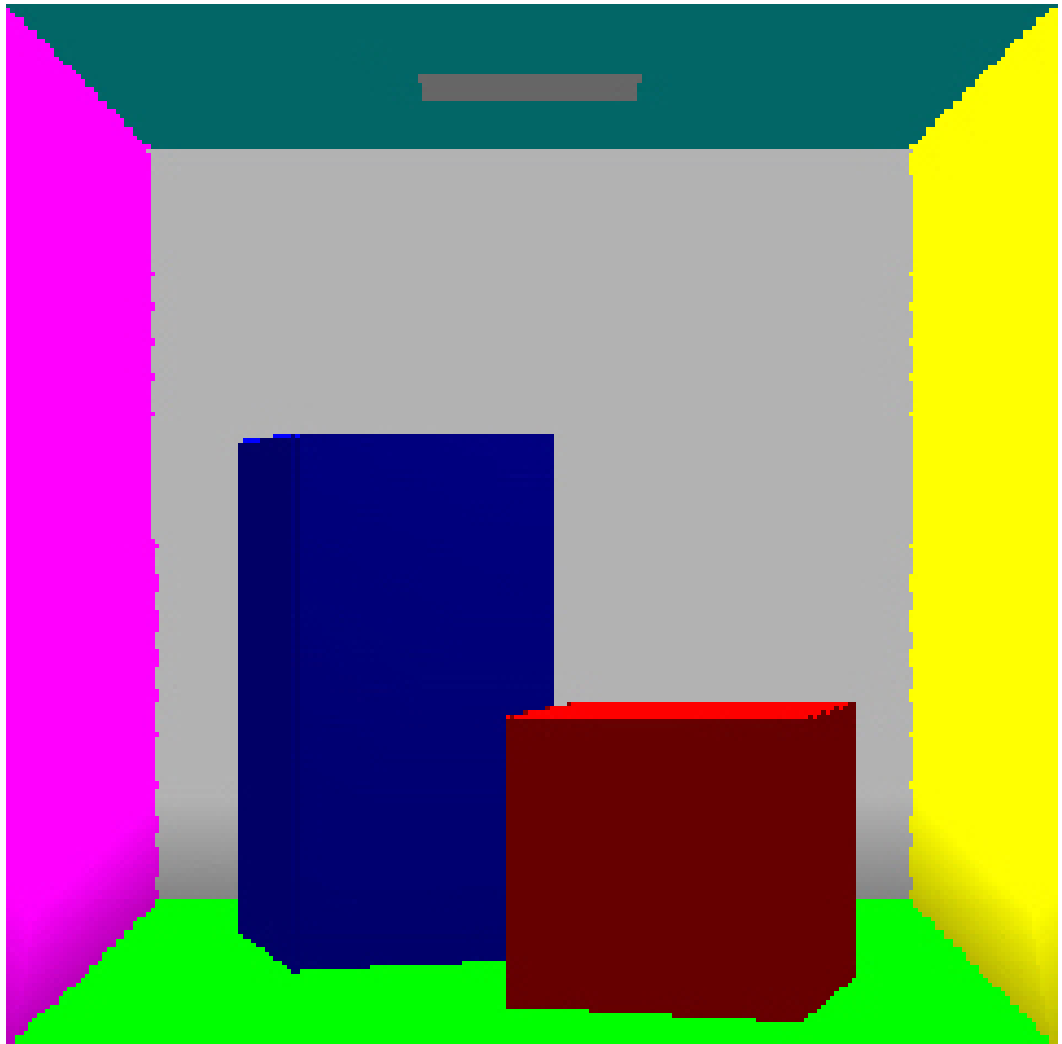
Change in perspective 2



Change in perspective 3



Change in perspective 4



Strangely familiar ?

Does this "deepening" effect look familiar ?

You will have seen it many times in film & cinema

For example in the 1970s horror classic:

jaws

https://www.youtube.com/watch?v=NB4bikrNzMk

Dolly Zoom 1

Dolly Zoom 2

Dolly Zoom 3

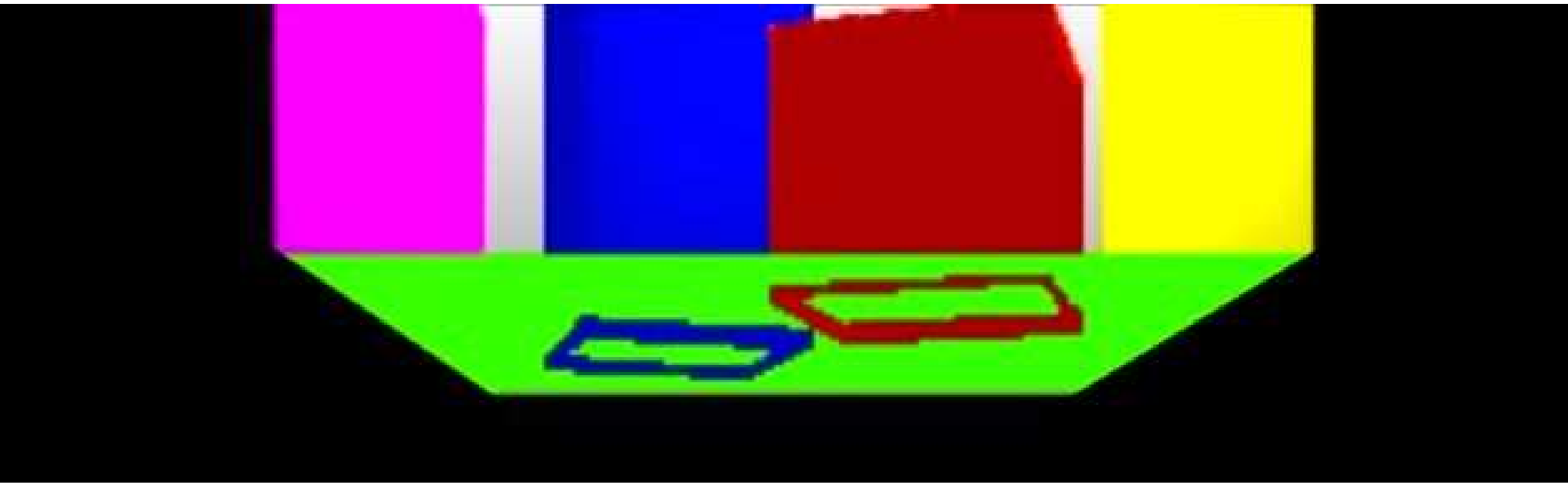
Dolly Zoom 4

Oh noz ! My floor is broken !!!

It is normal to see an occasional "peek through"

(Due to close proximity and accumulated error)

But it shouldn't be as severe as the following...

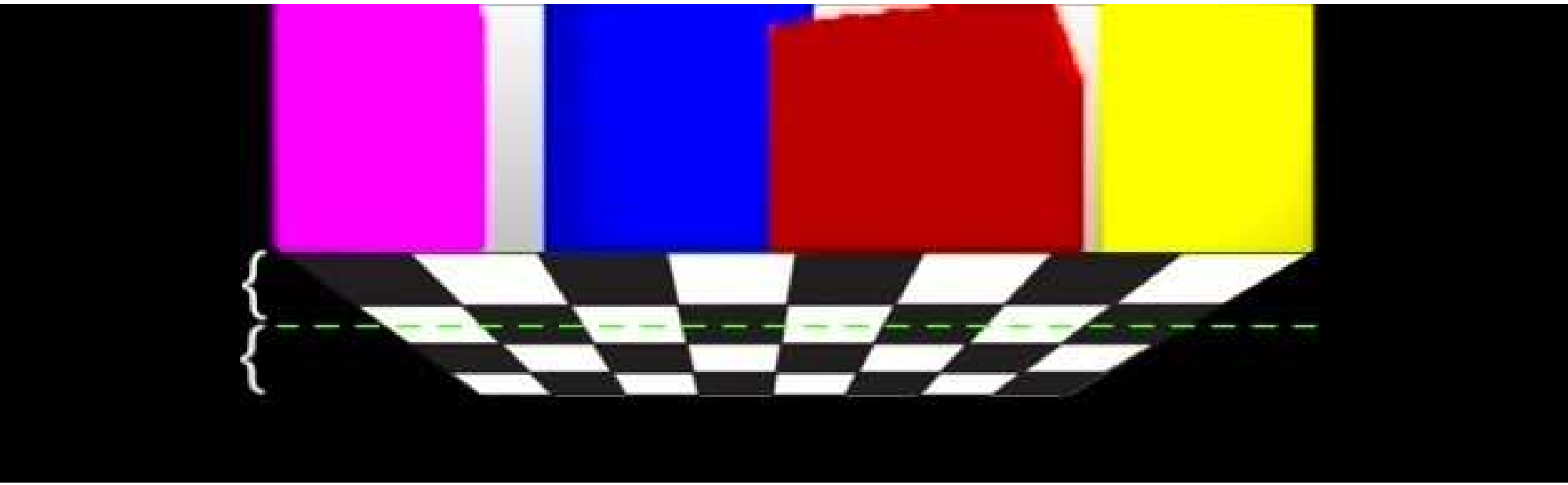


The reason ? Perspective !

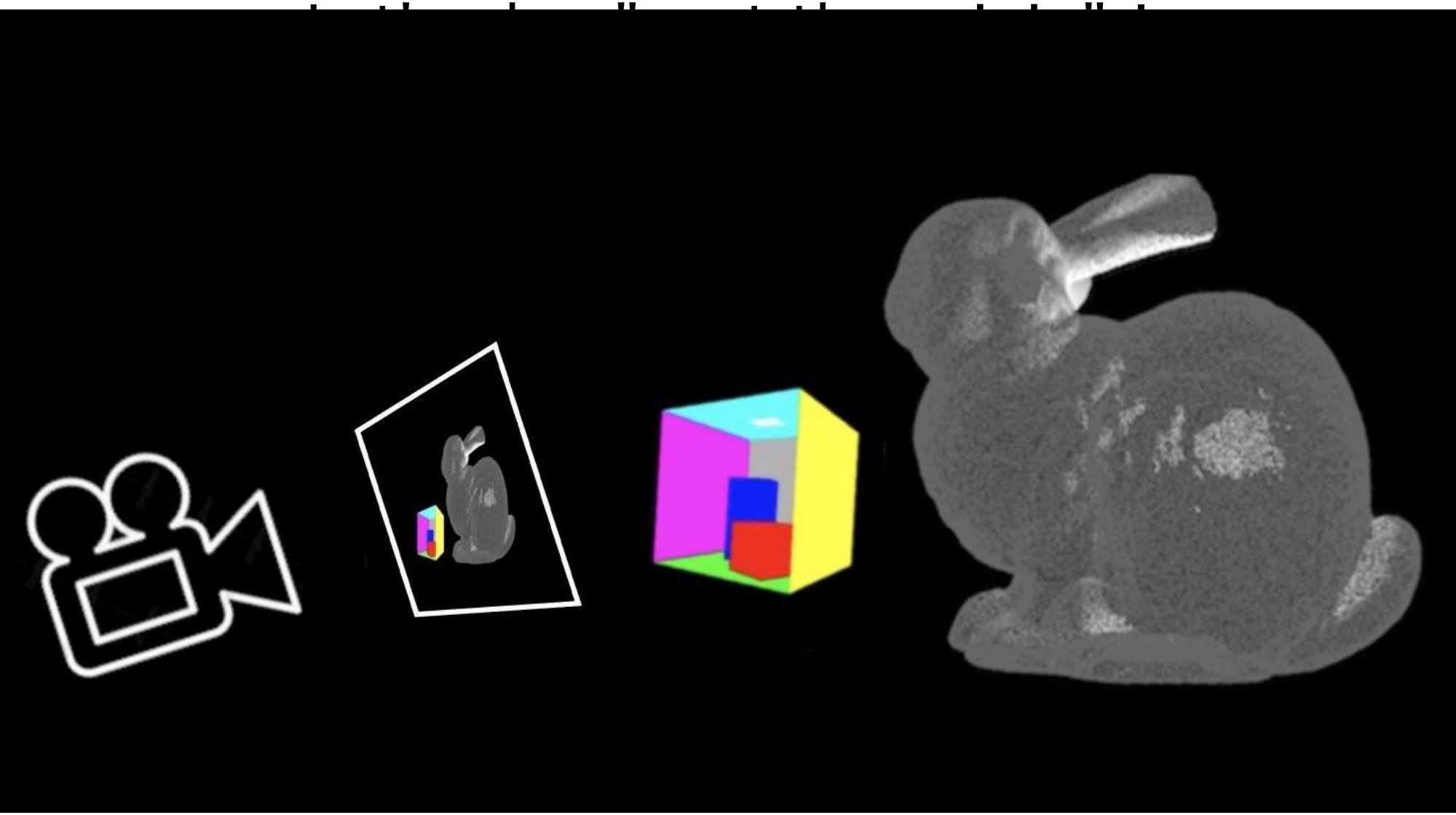
Due to perspective, calculation of Z Depth is NOT linear

For a given change in Y, the change in Z will vary !!!

Dotted line is at half Y height of floor, but NOT half Z



Time for a quick game ?



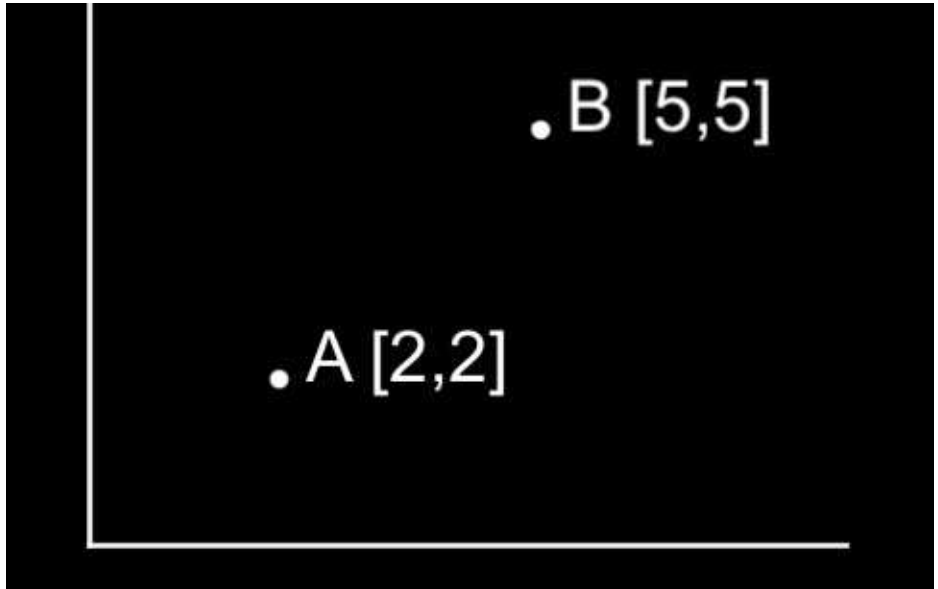
Transposition

For many of the rendering features we will explore...

We must shift positions between coordinate systems

Locate a certain point RELATIVE to a specific origin

Helpful trivial example: Where is B relative to A ?



And finally...

TheIncredibleShrinkingBuilding

Your task is to think about:

What causes the building to *appear* to shrink ?