09 Shadow Mapping

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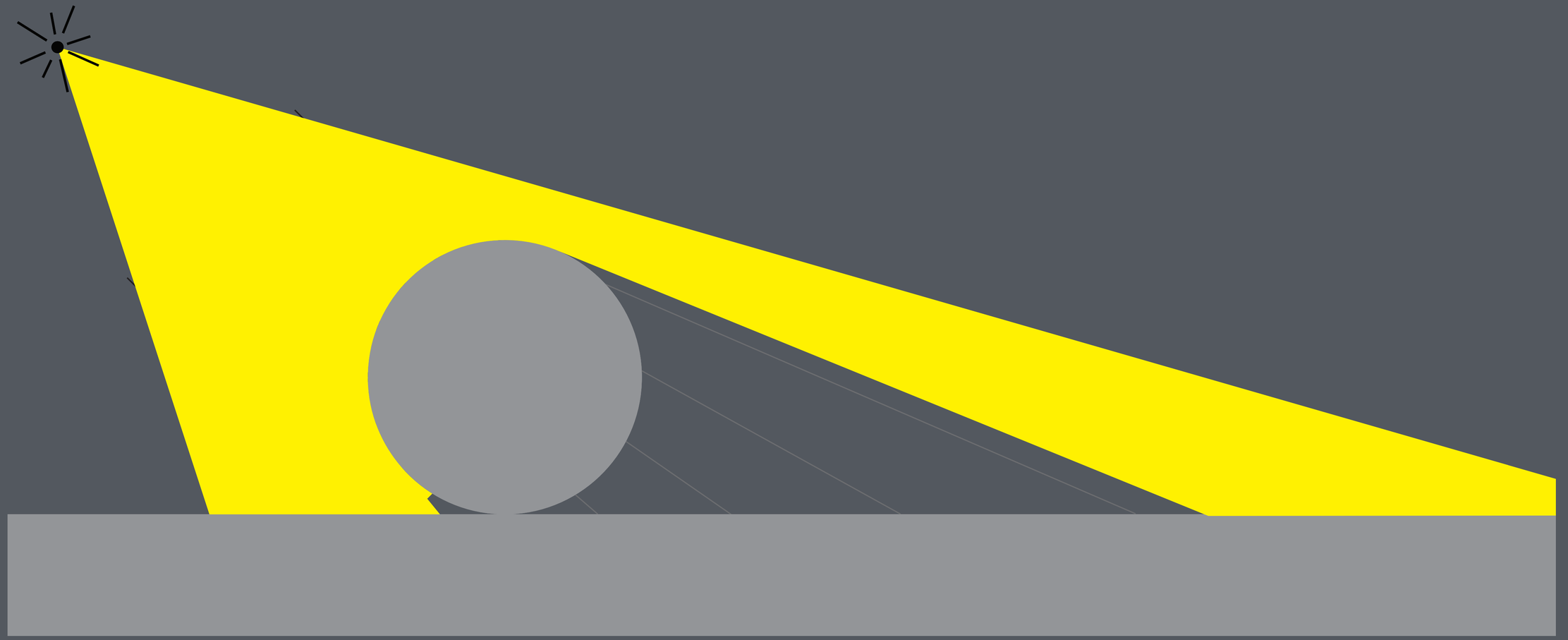
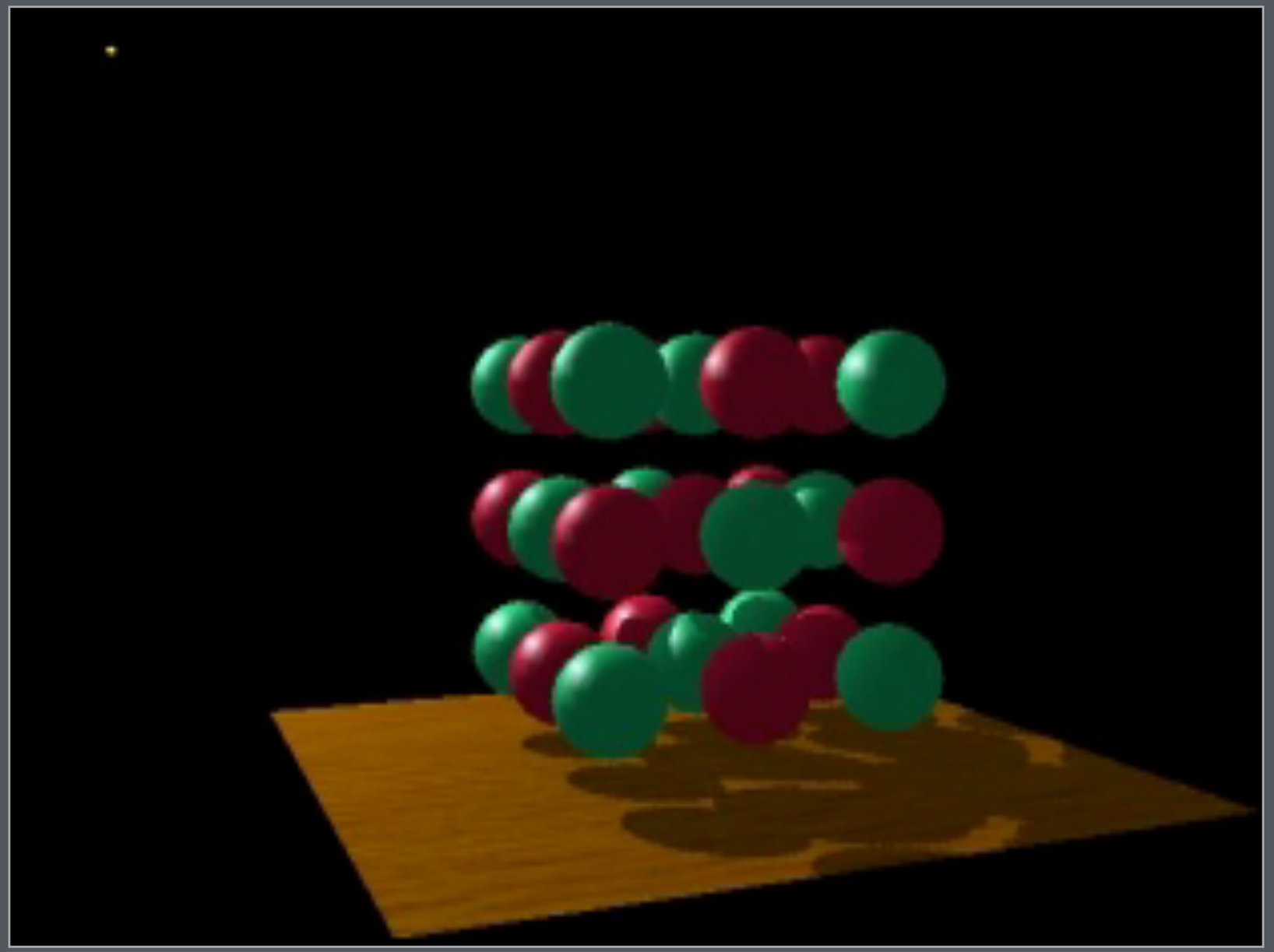
CS5625 Spring 2015

Thanks to previous instructor Kavita Bala





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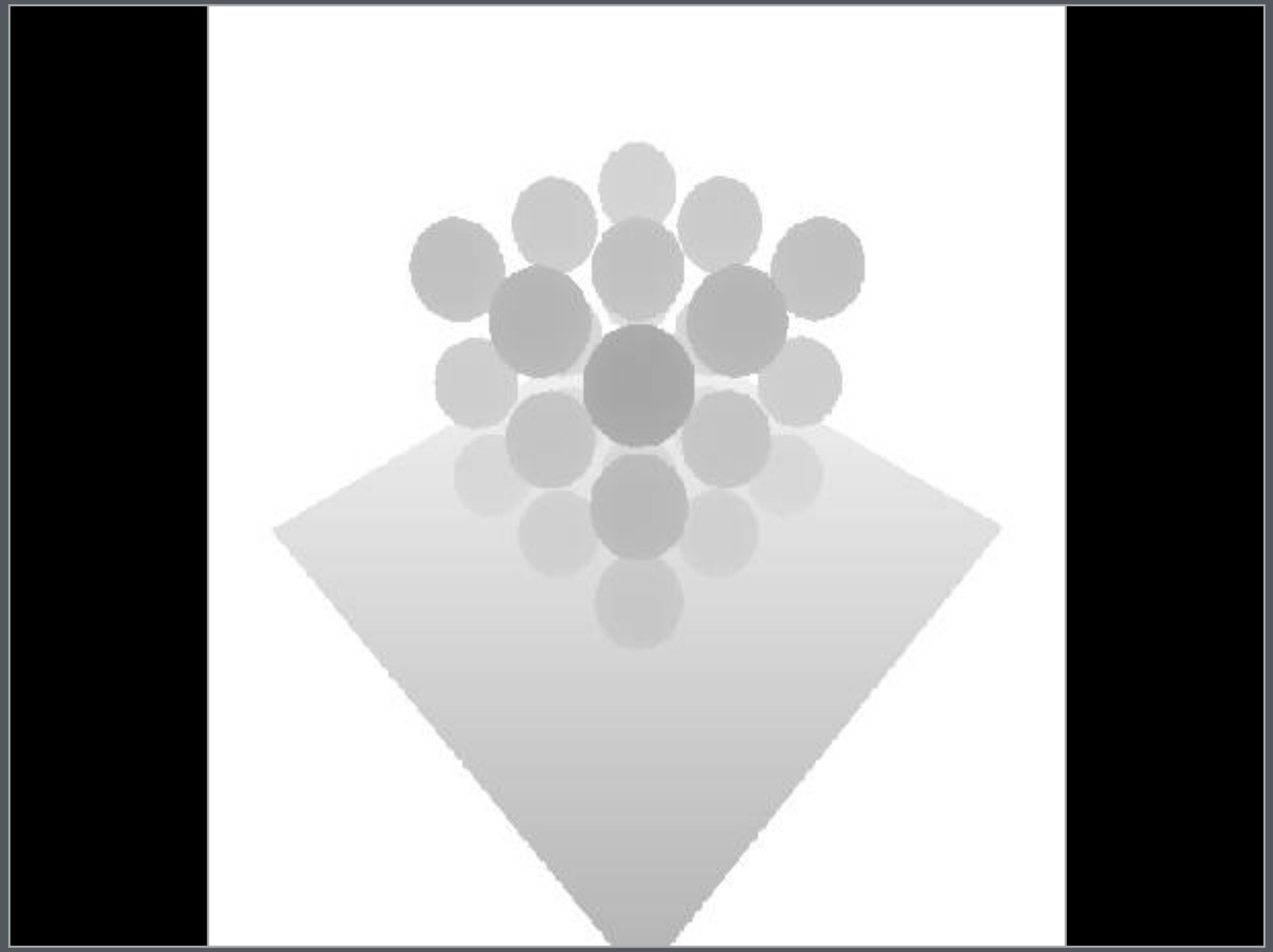

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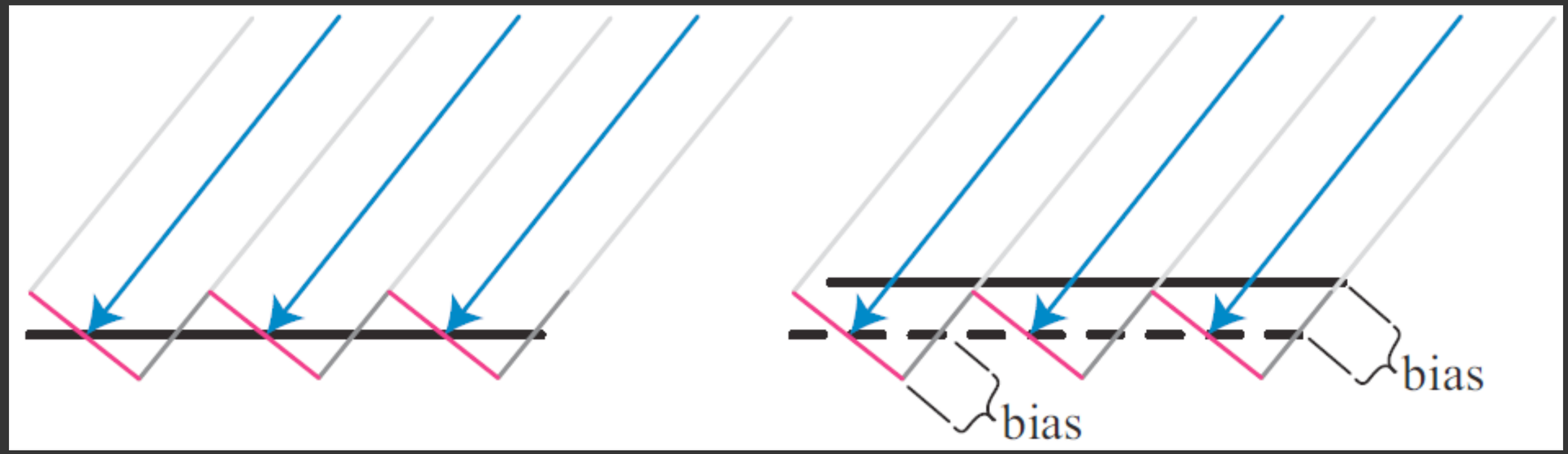
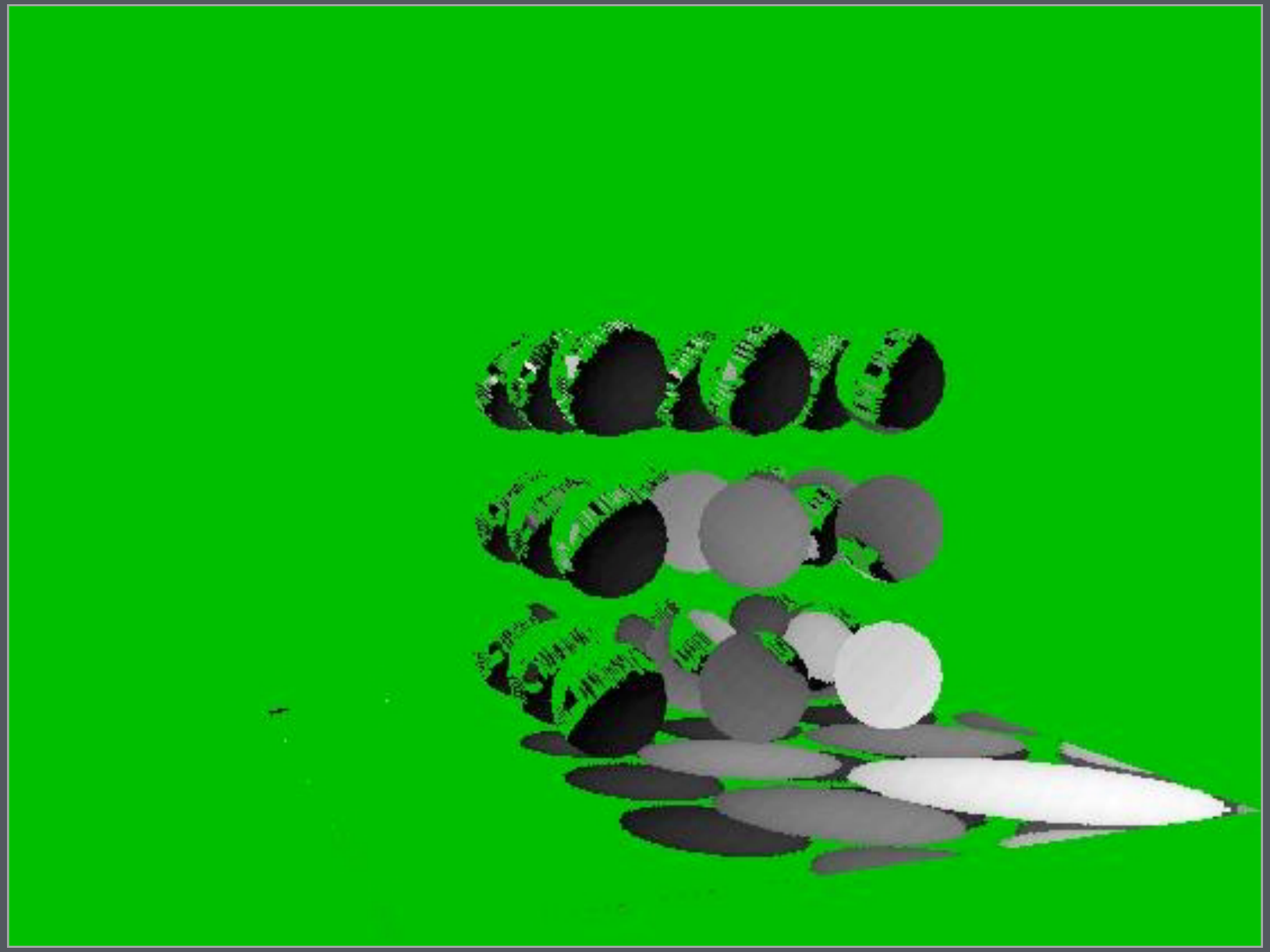
Shadow Map Issues

- if A and B are approximately equal?
- Speckling



slide courtesy of Kavita Bala, Cornell University



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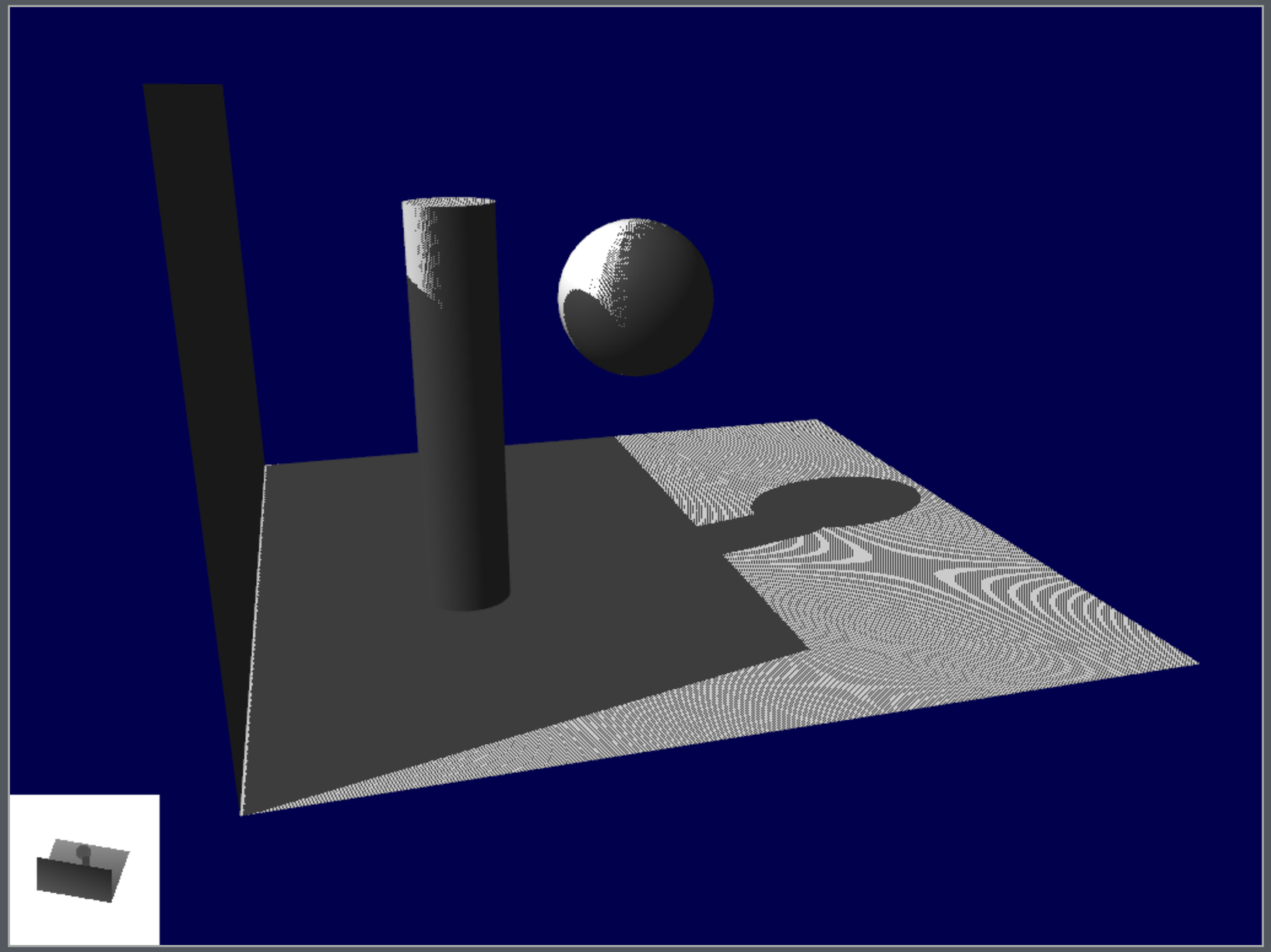

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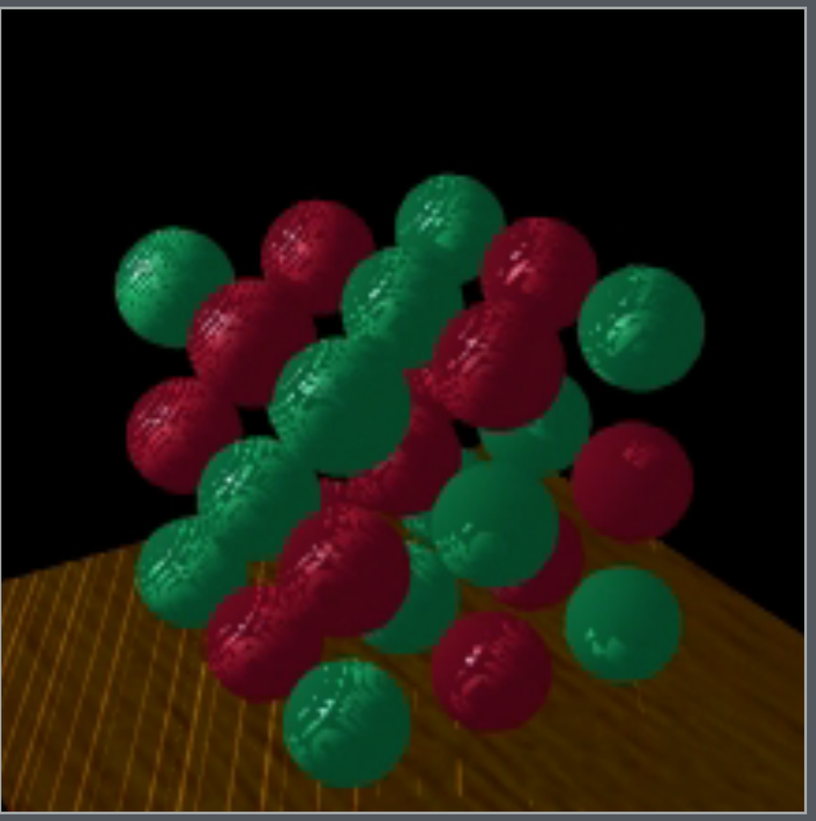
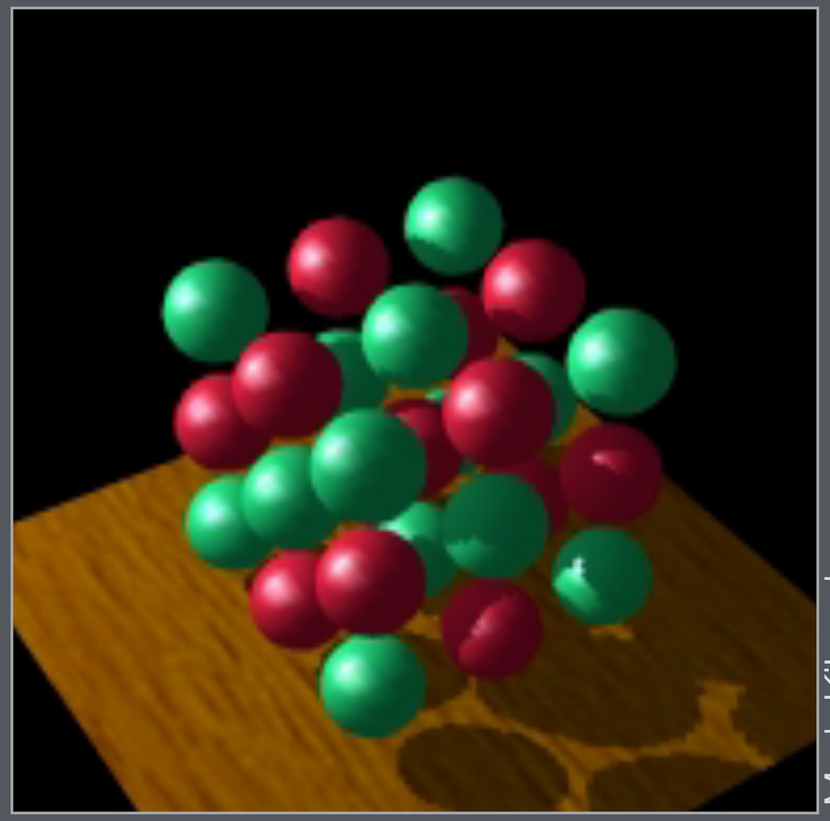
first try at shadow mapping



not enough shadow bias



good shadow bias

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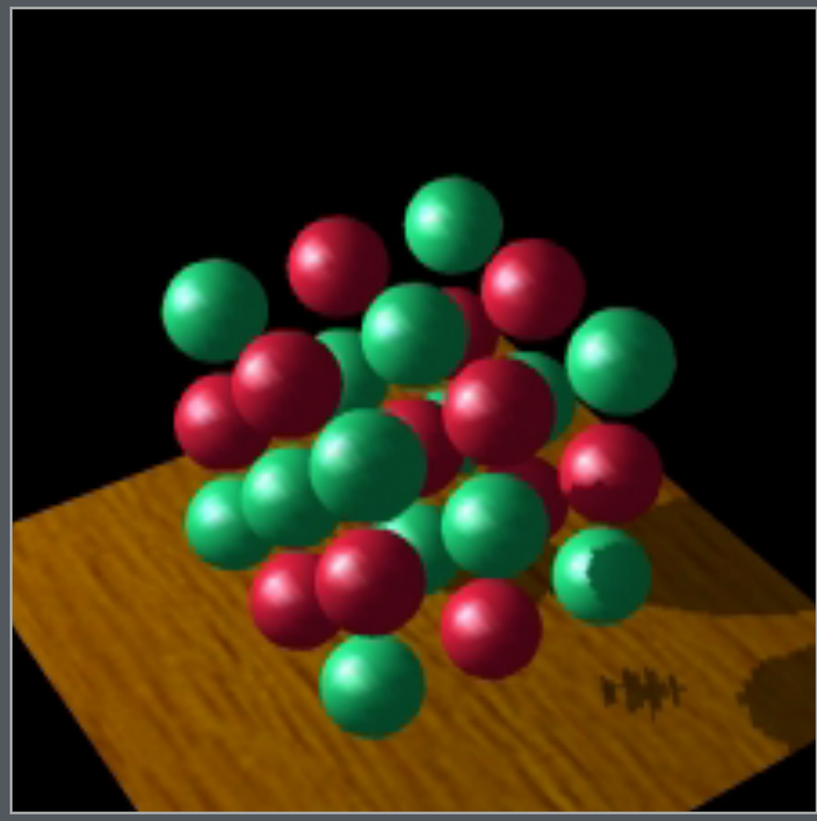
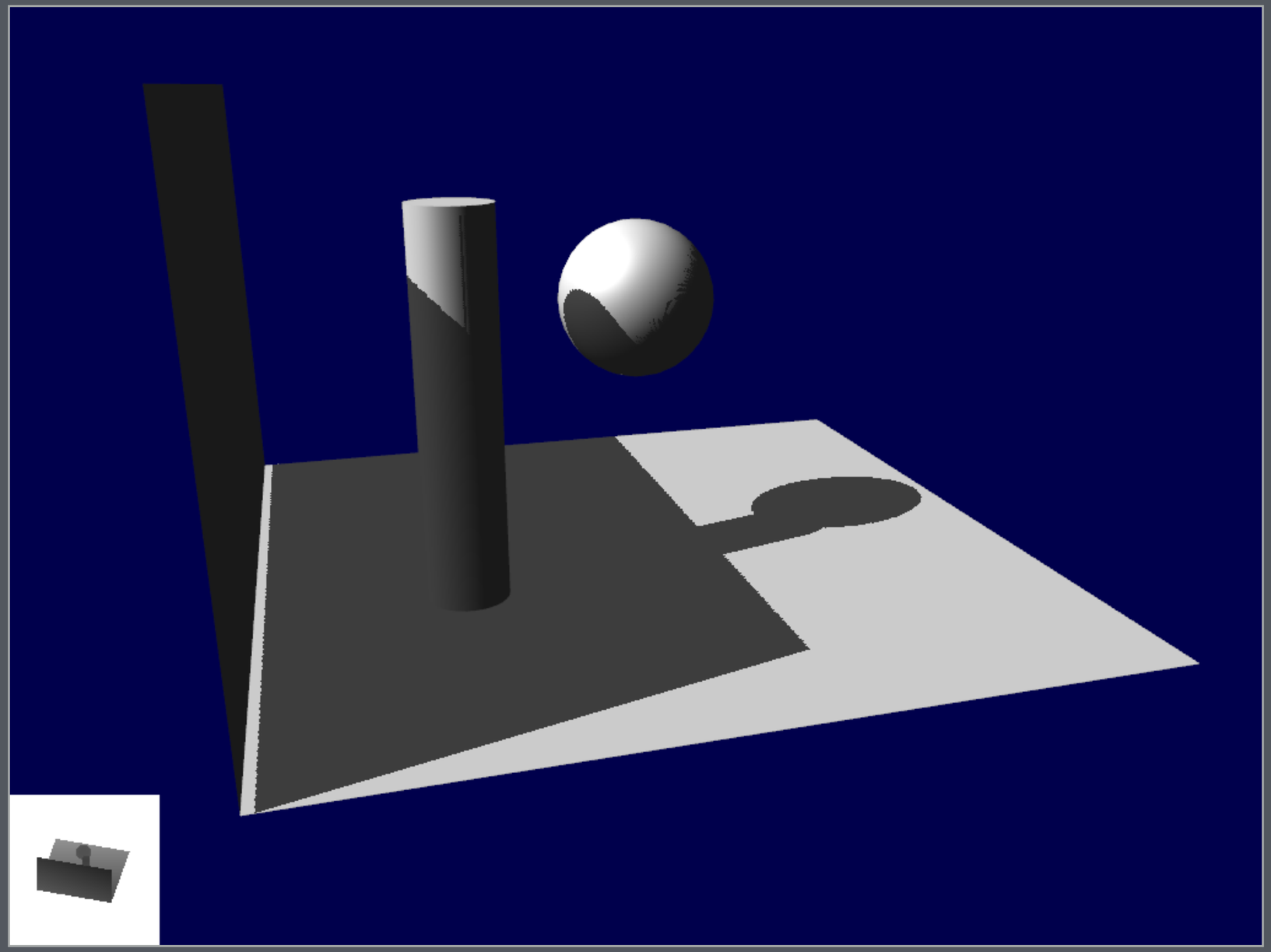


too much shadow bias



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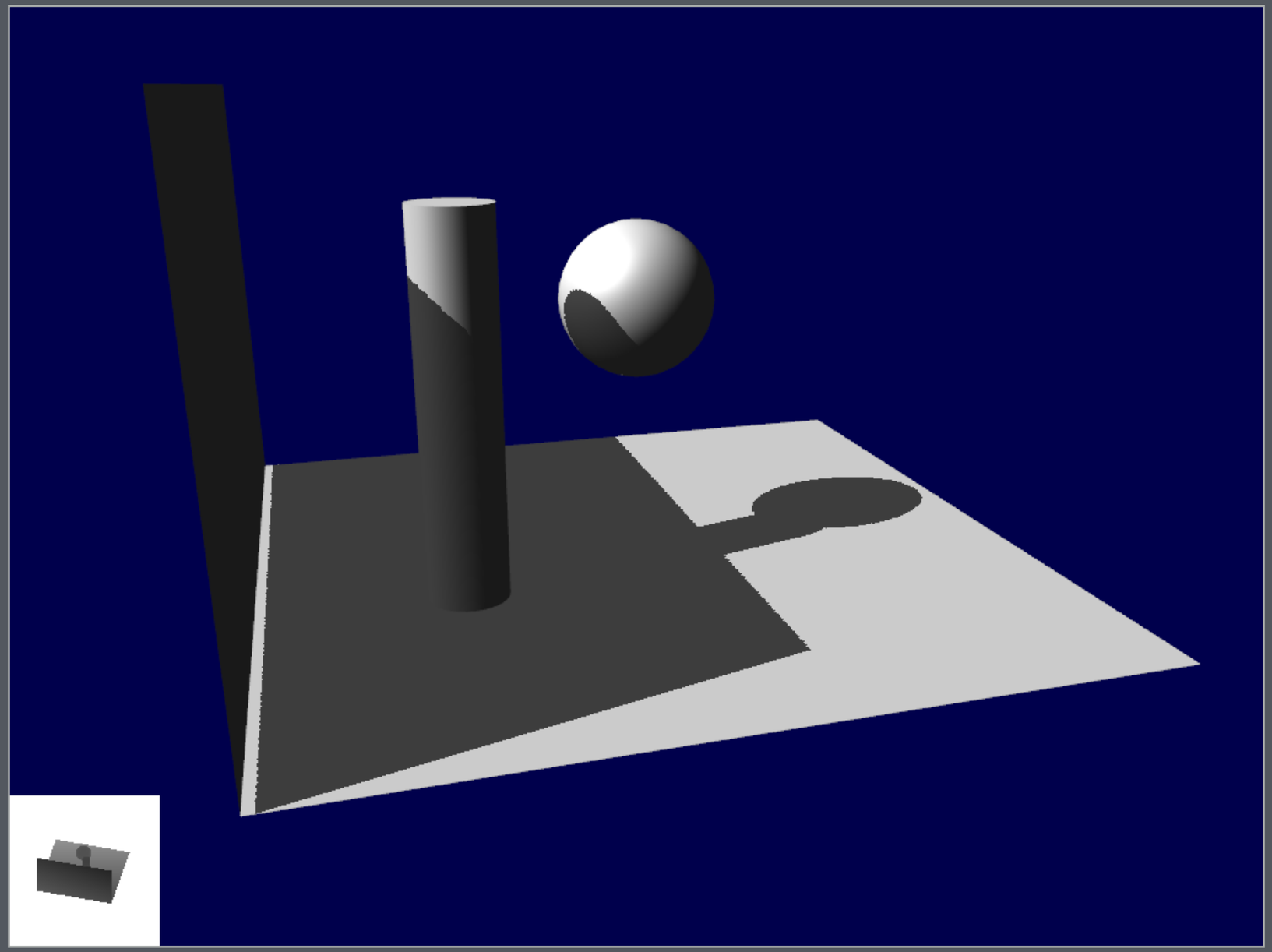
shadow mapping with constant bias



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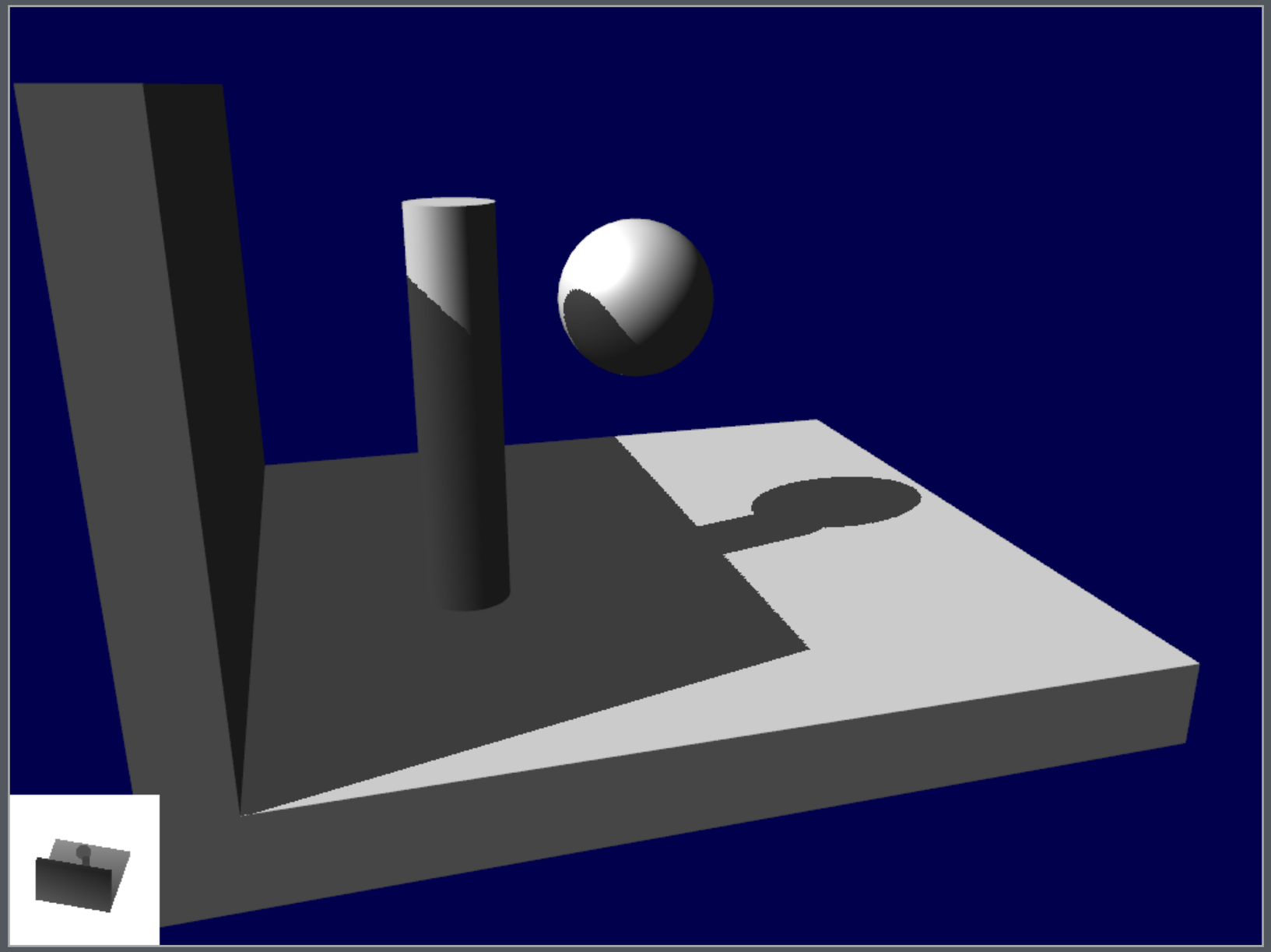
shadow mapping with slope-dependent bias



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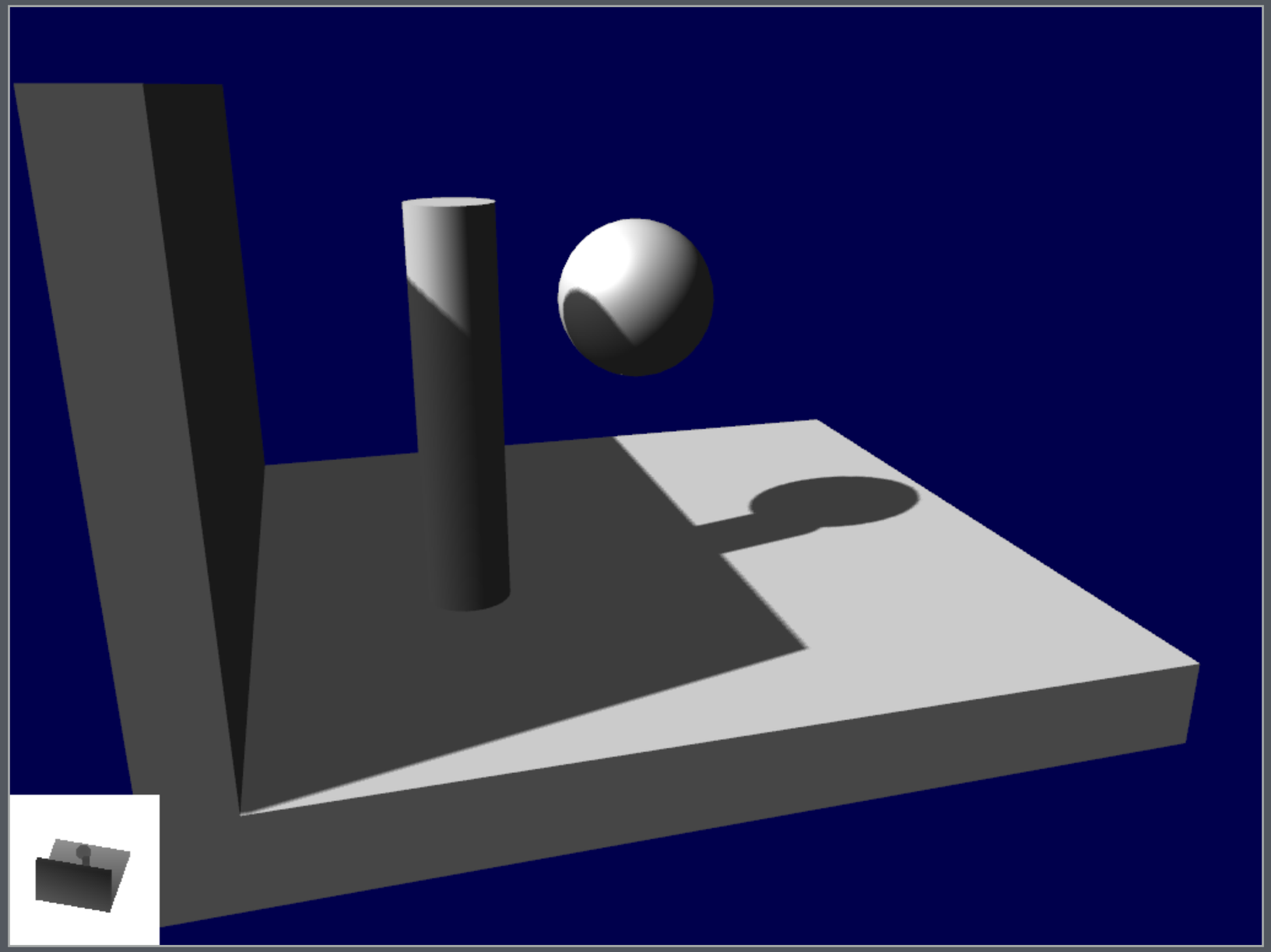
closed surfaces and slope-dependent bias



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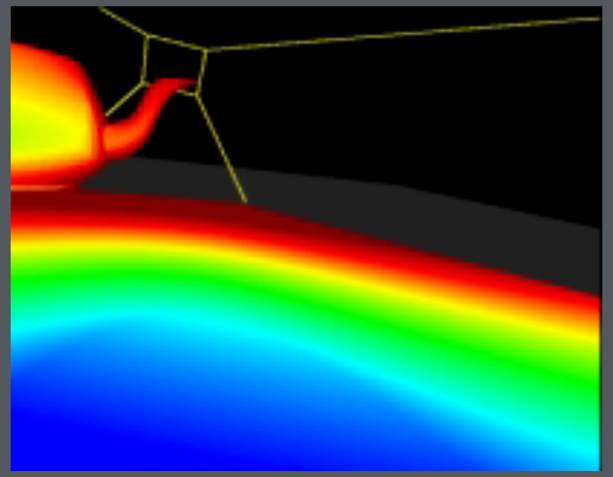
adding percentage-closer filtering

Shadow map sample rate—bad case

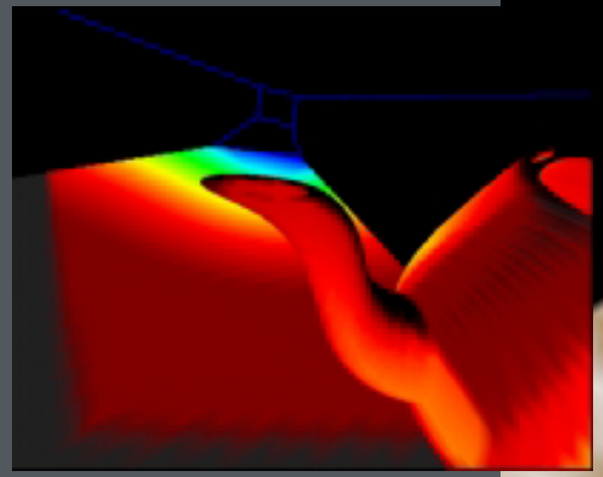
Light behind object

Light's "view direction" almost opposite the eye's view direction

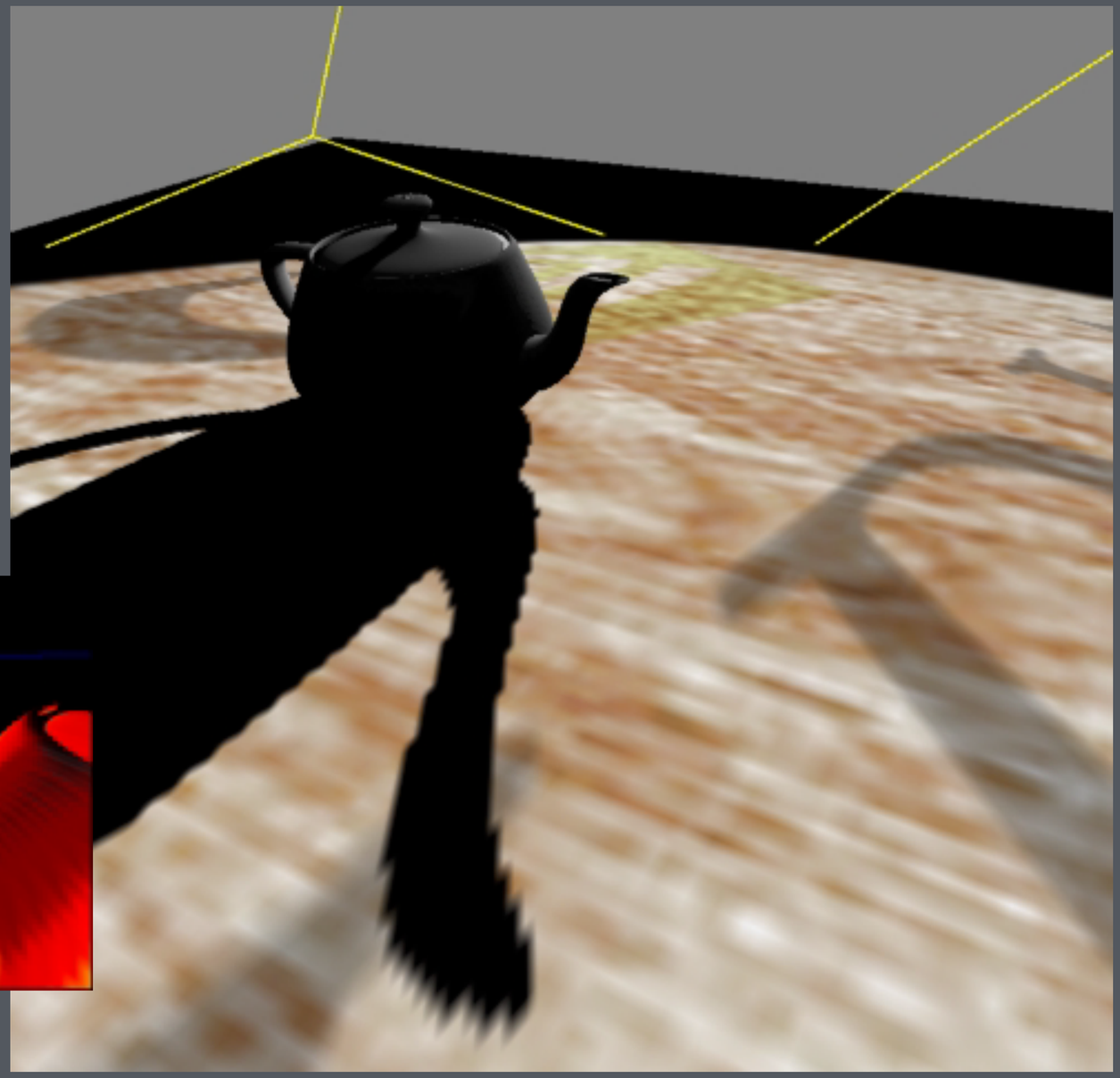
"Dueling frusta"



eye view



light view



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Filtering shadow maps

Shadow map lookups cause aliasing, need filtering

As with normal maps, pixel is a nonlinear function of the shadow depth

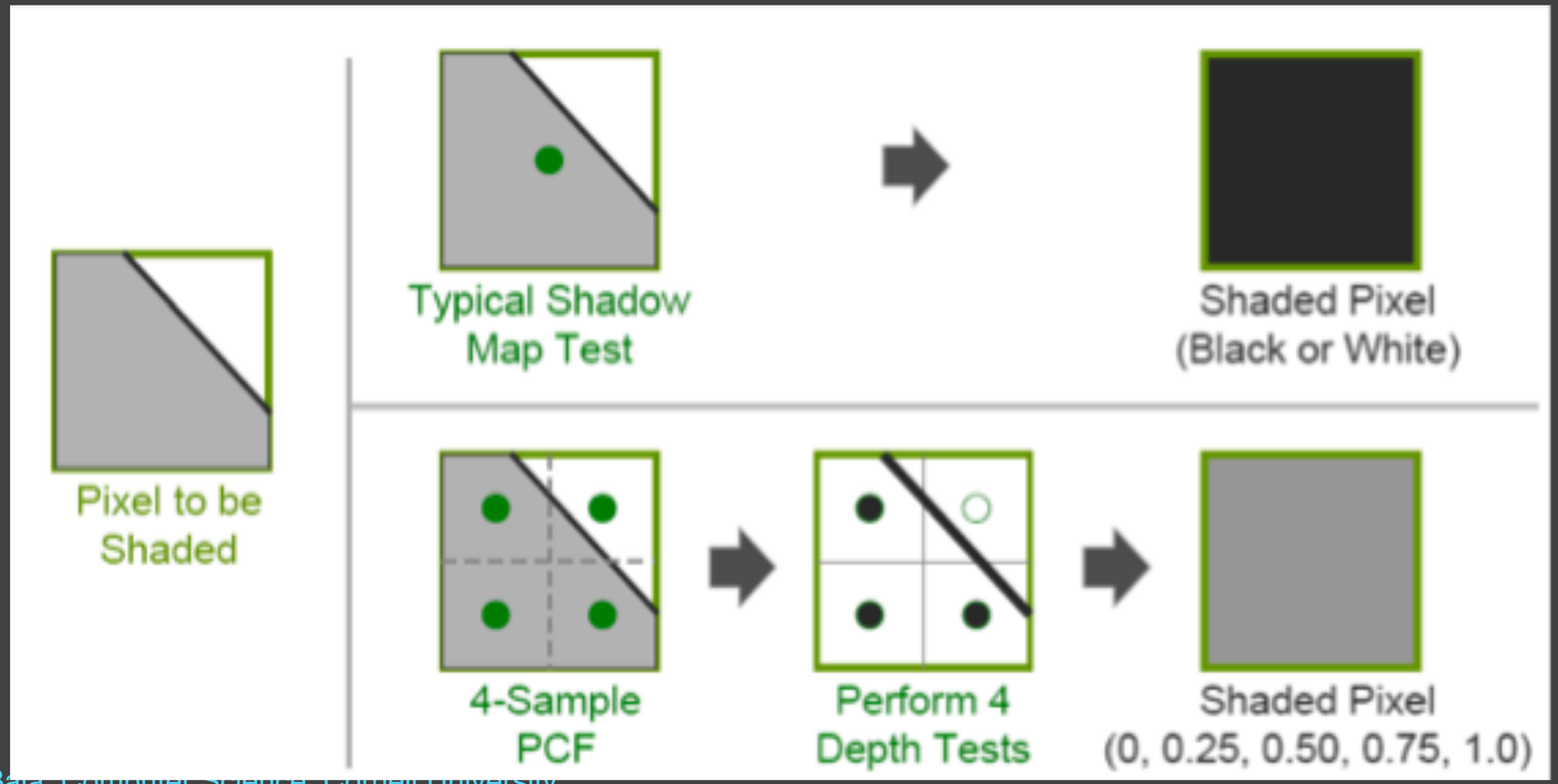
- this means applying a linear filter to the depth is wrong

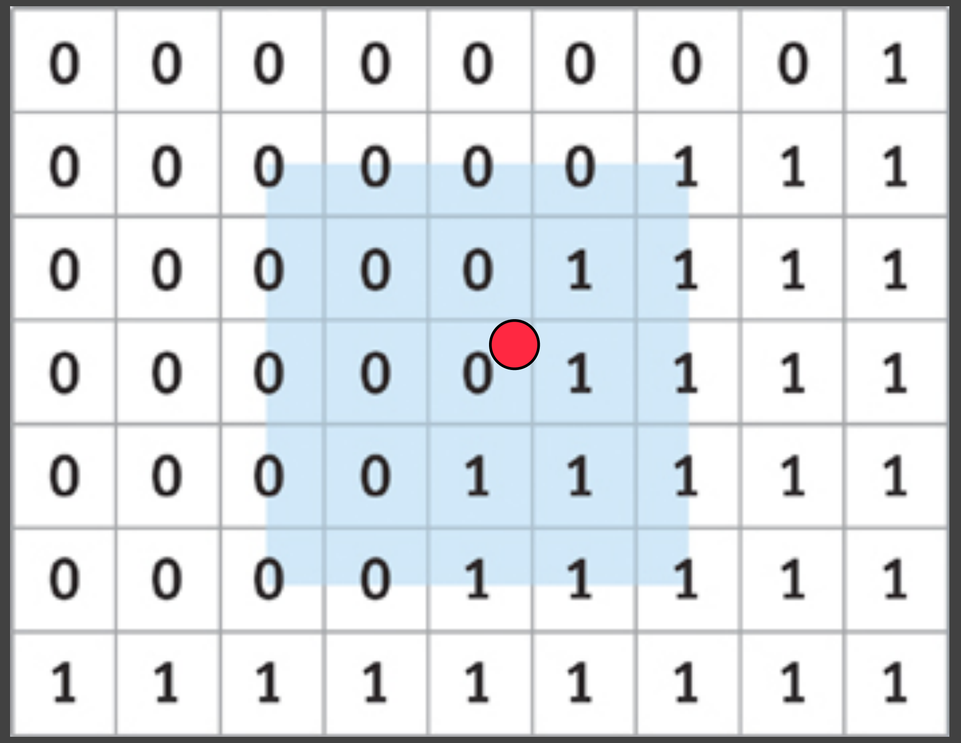
We want to filter the output, not the input, of the shadow test

- what fraction of samples pass the test
- samples pass the test if they are closer than the shadow map depth
- therefore “percentage closer filtering” or PCF

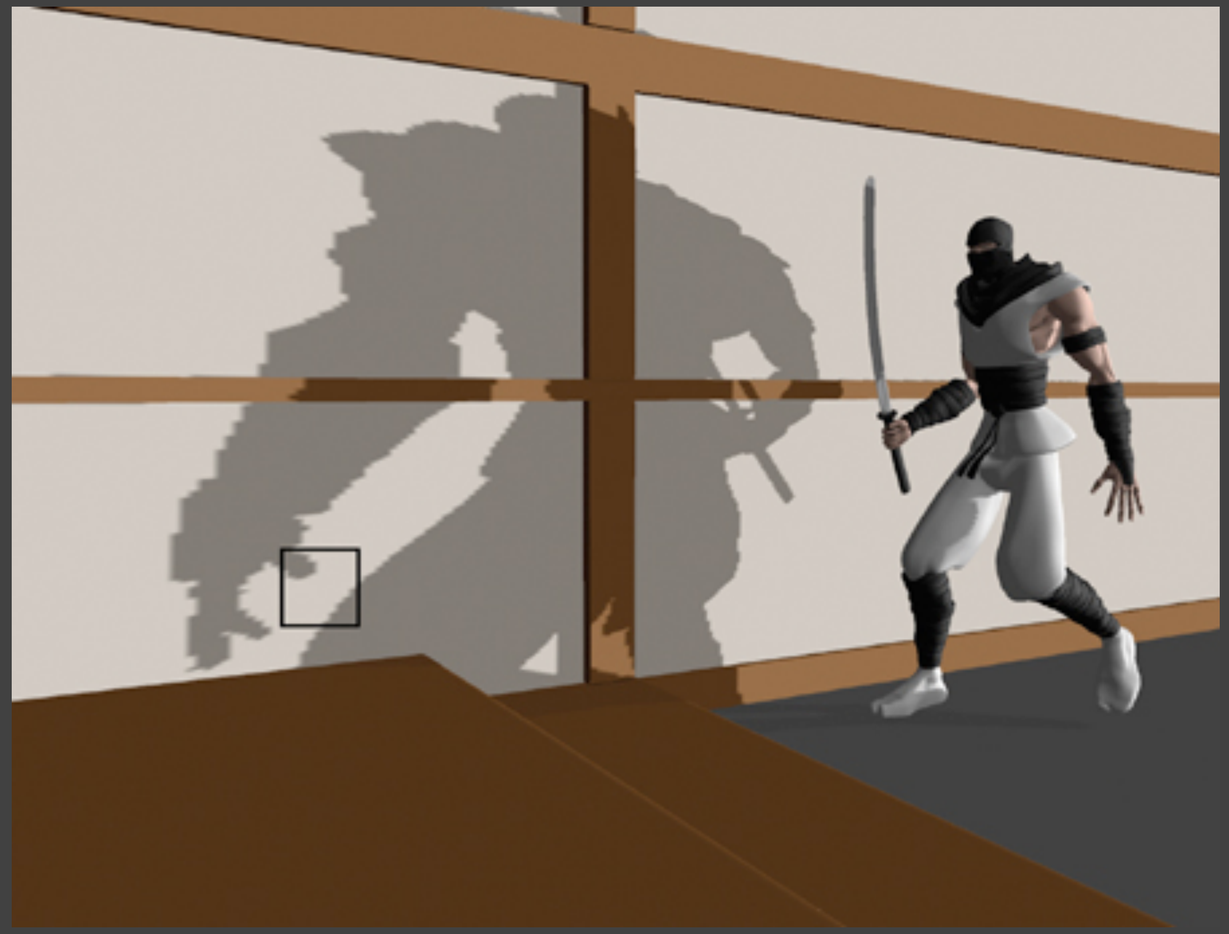
Percentage Closer Filtering

- Soften the shadow to decrease aliasing
  - Reeves, Salesin, Cook 87
  - GPU Gems, Chapter 11



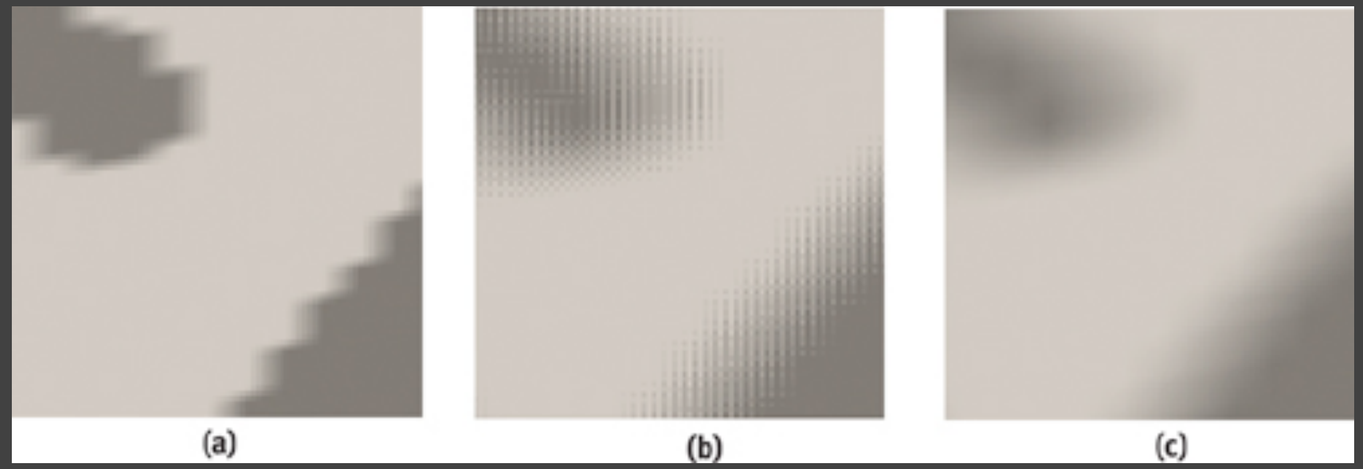

0 0 0 0 0 0 0 0 1
0 0 0 0 0 0 1 1 1
0 0 0 0 0 1 1 1 1
0 0 0 0 0 1 1 1 1
0 0 0 0 1 1 1 1 1
0 0 0 0 1 1 1 1 1
1 1 1 1 1 1 1 1 1

1 sample SM



4 sample PCF

16 sample PCF


(a)
(b)
(c)