Ray Tracing, Part IV

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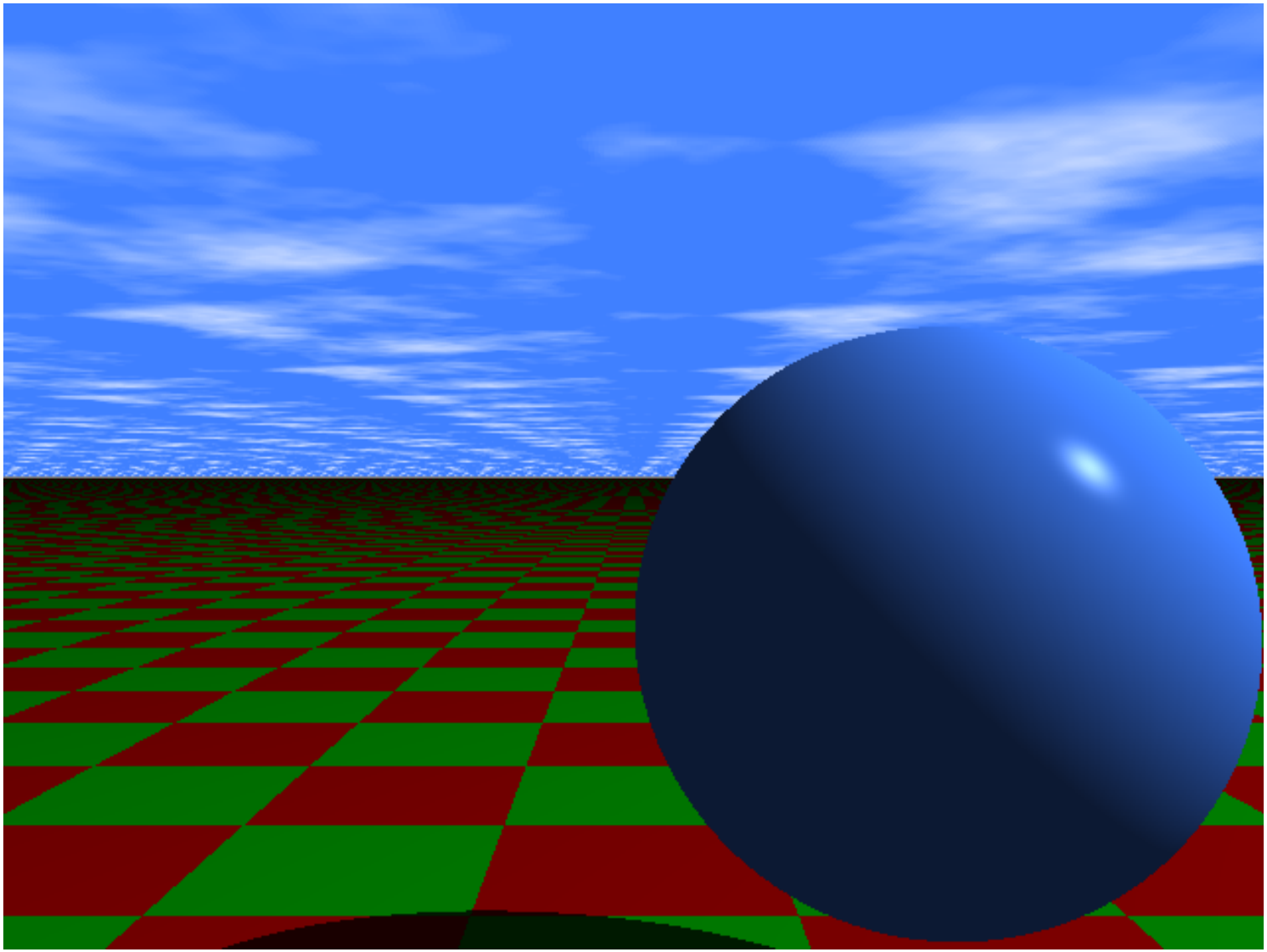
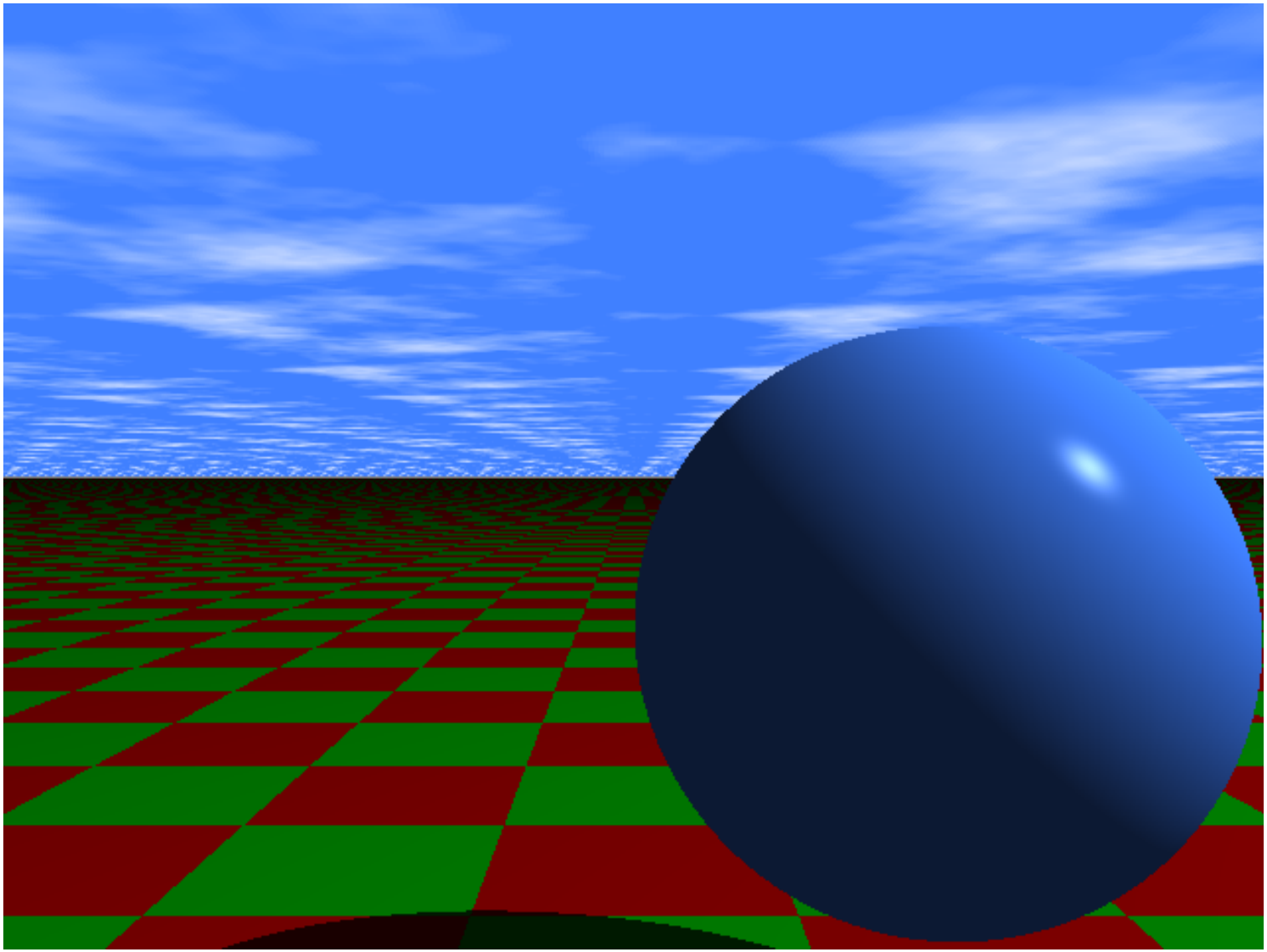
A simple scene

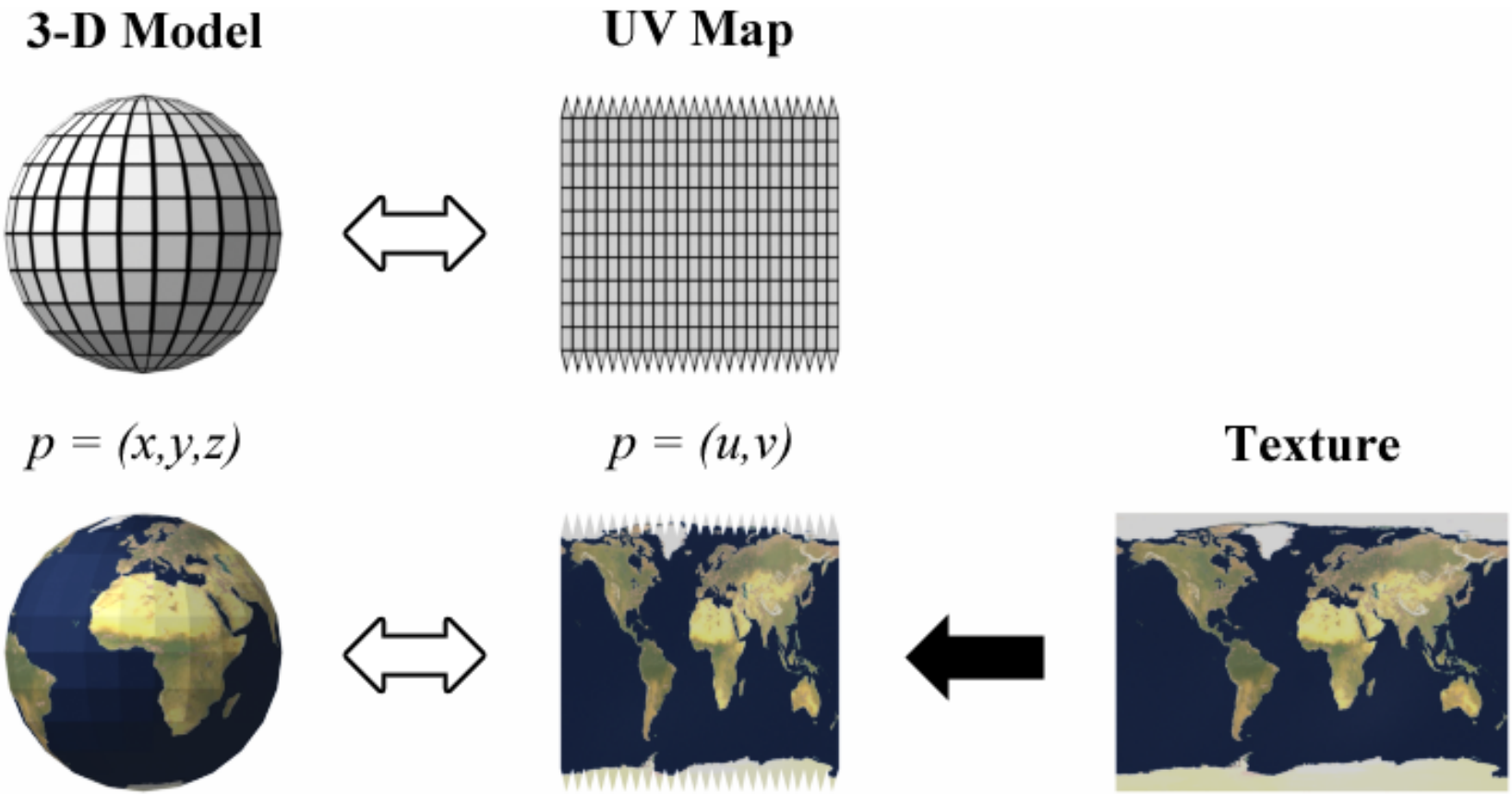


A simple scene



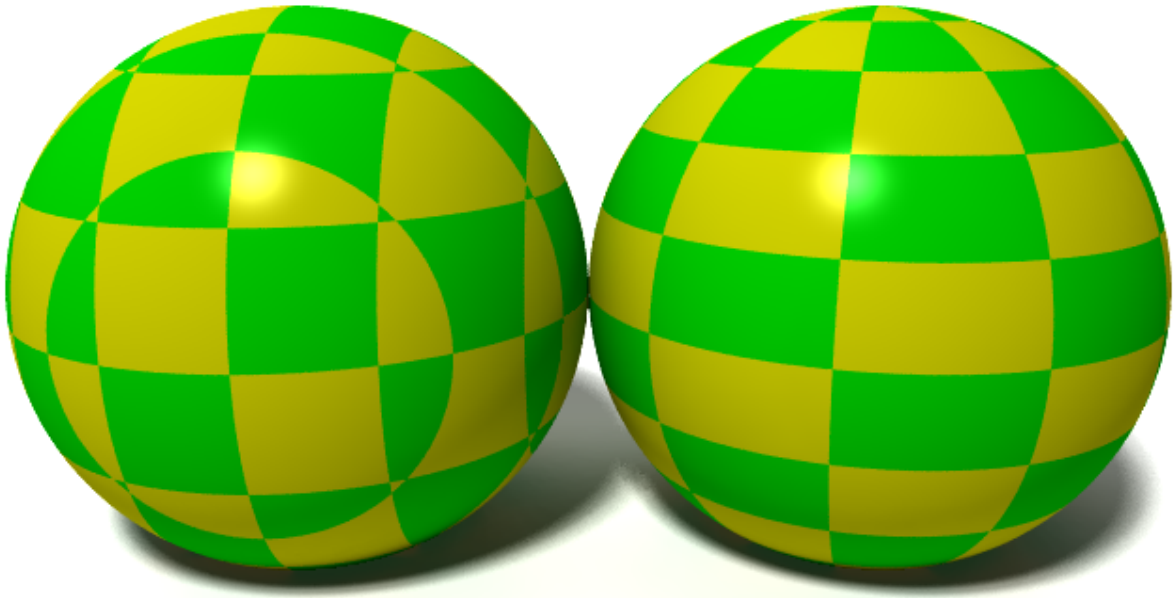
- How do we get more than one color on an object?

Textures and UV mapping



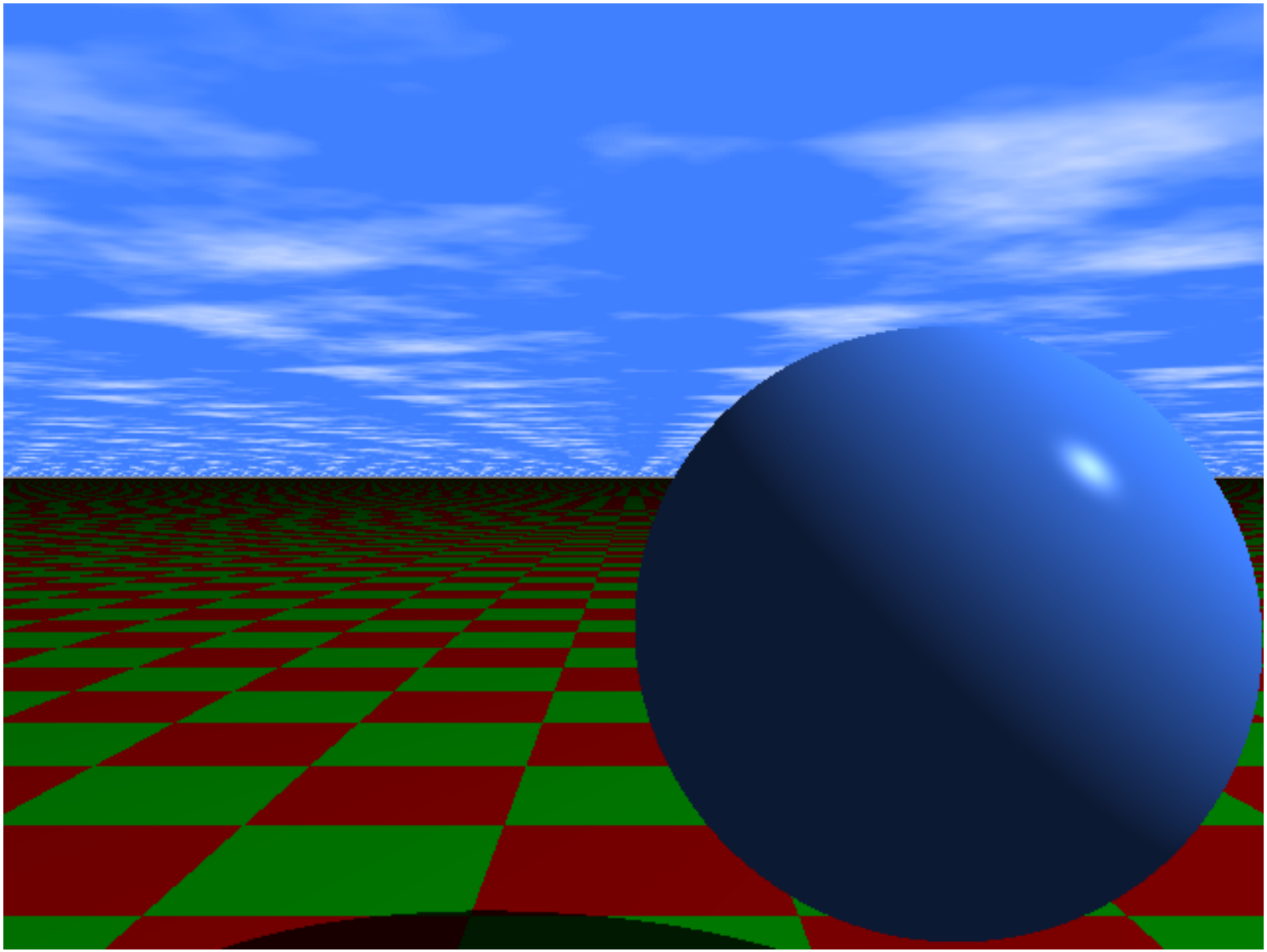
- Need to map point on surface to point in image.

2D and 3D mapping

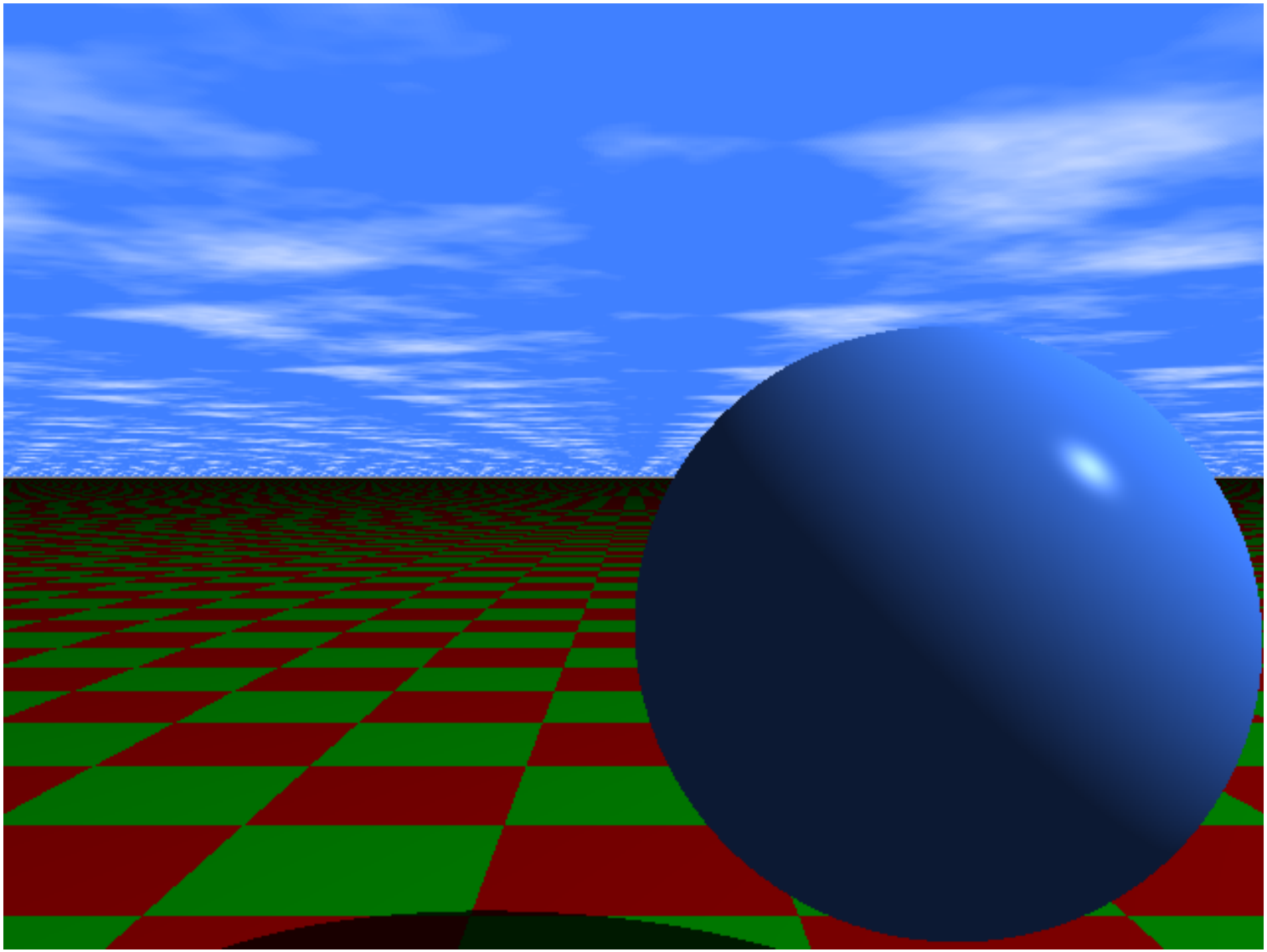


- Can be *procedural* rather than image texture.

A simple scene

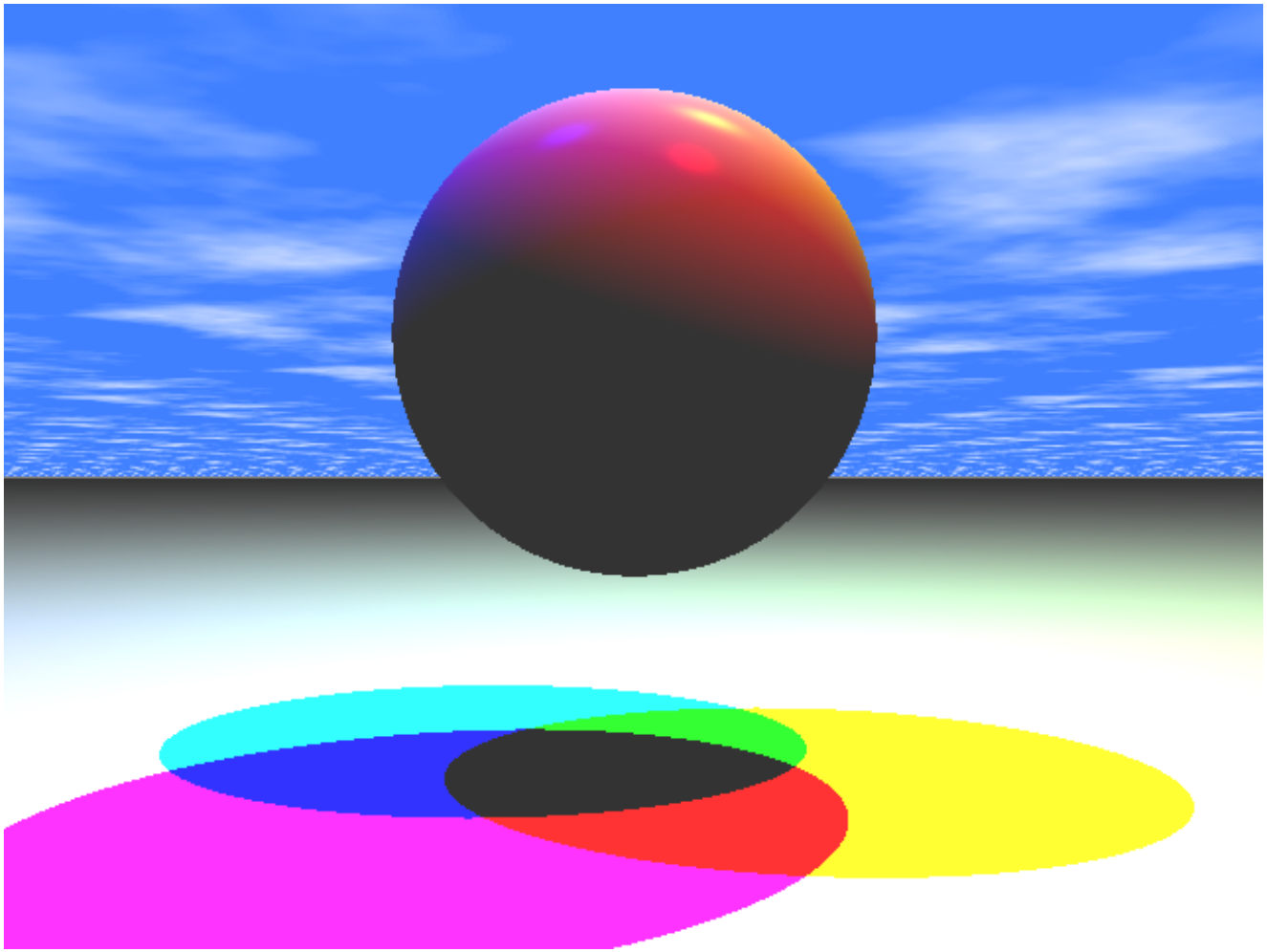


A simple scene



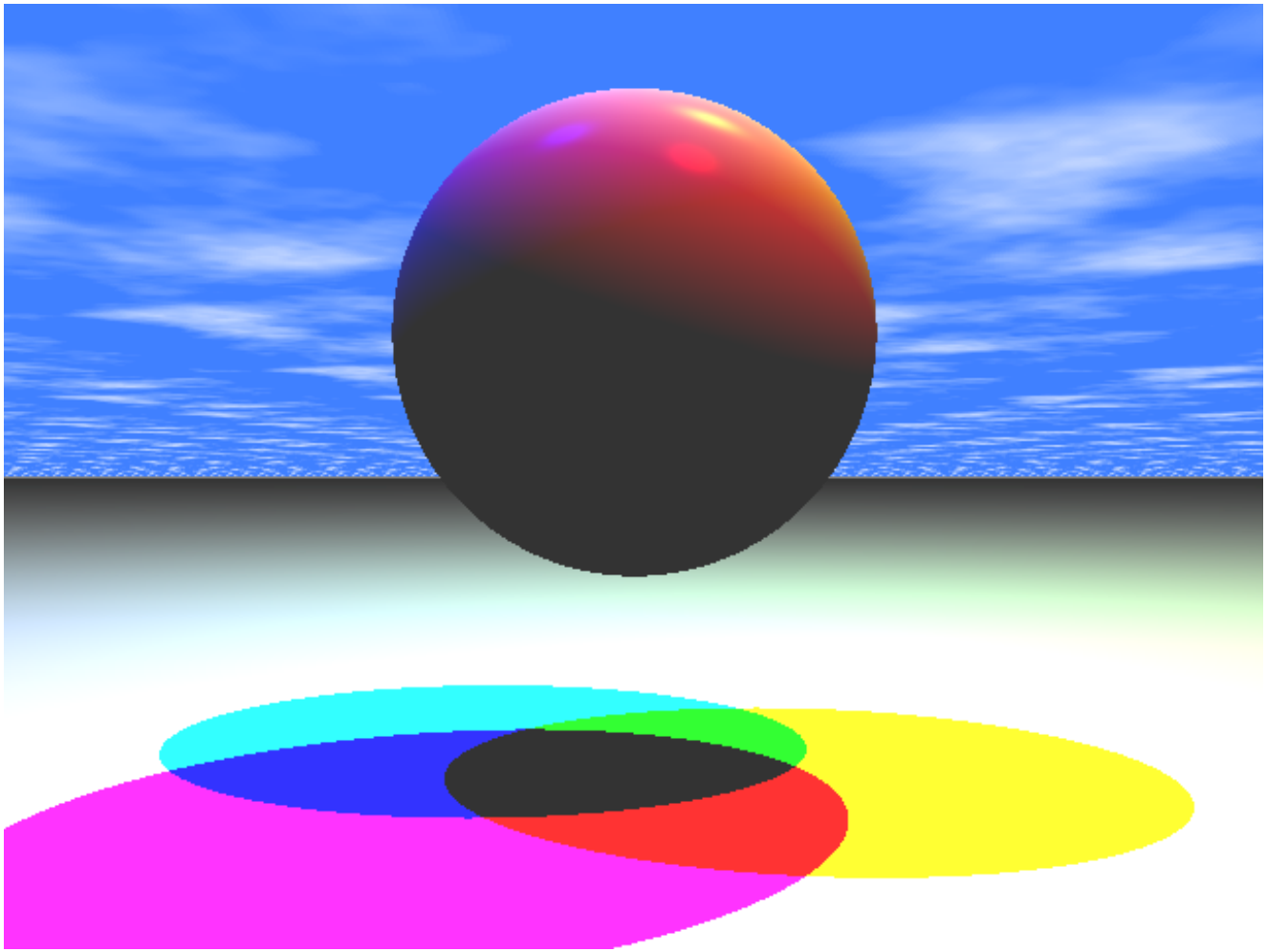
- How did we get the shadow?

Shadows



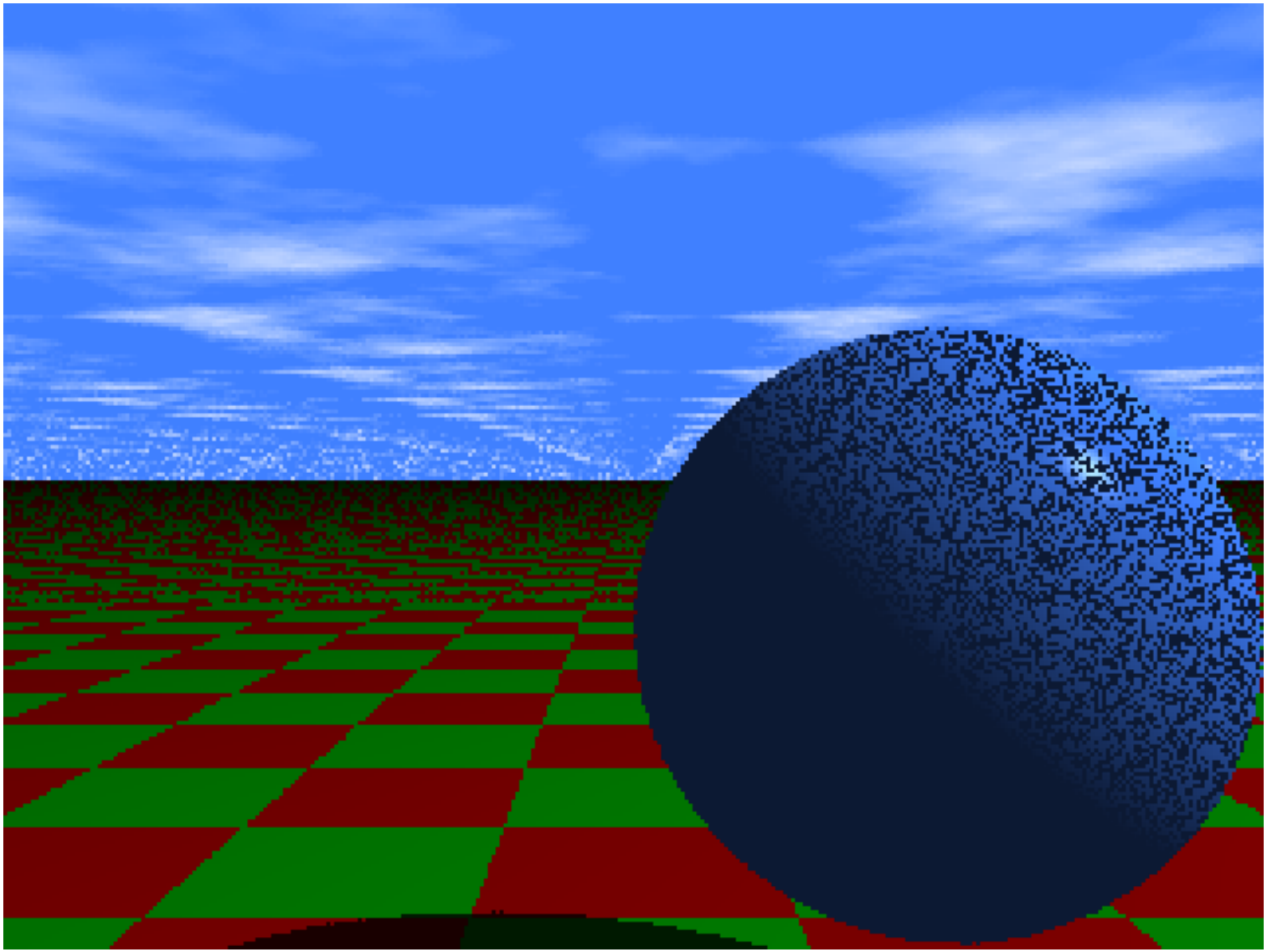
- Cast a ray from intersection to lights.
- Do not need closest intersection, can quit after one.

Shadows



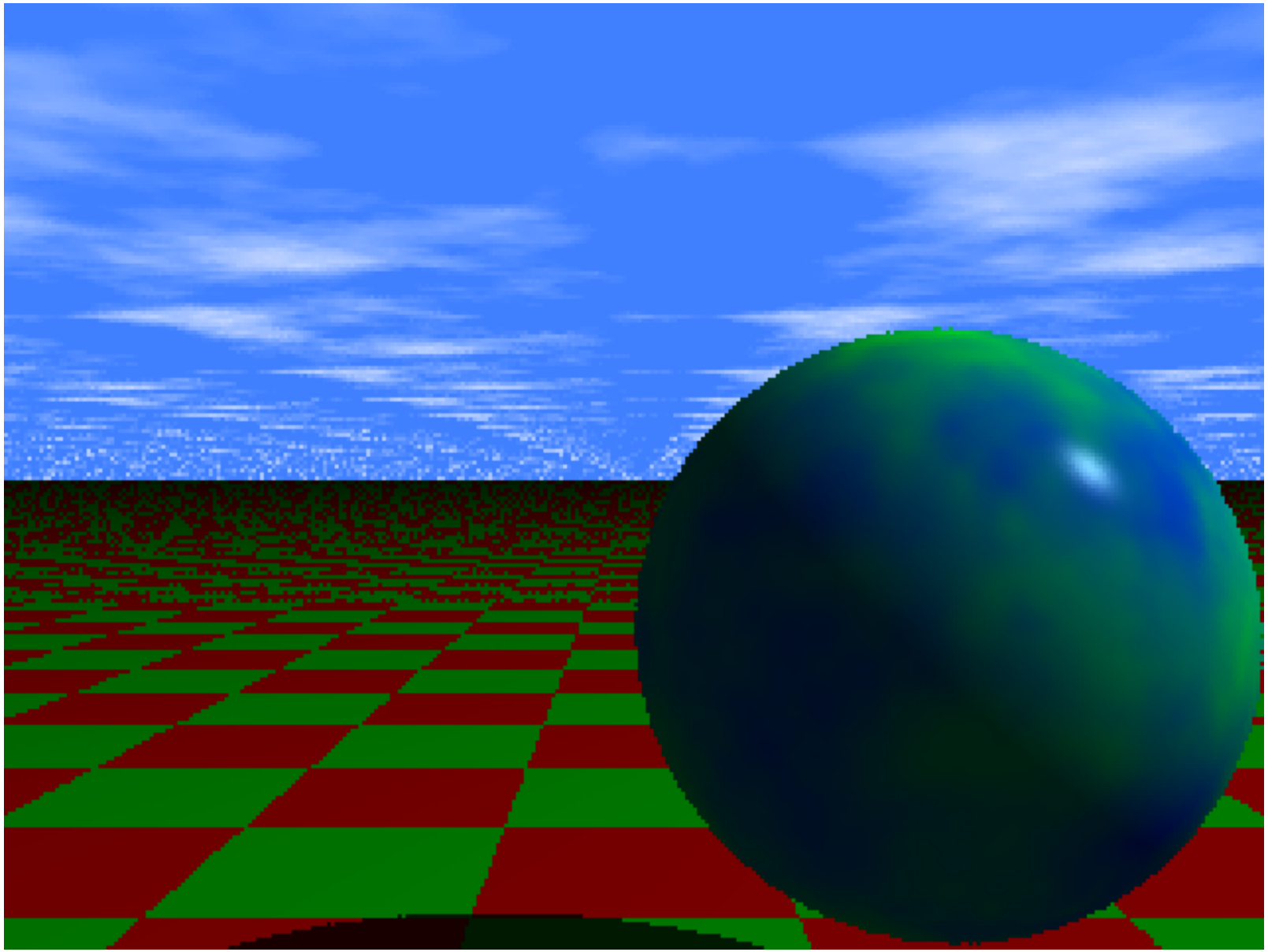
- Cast a ray from intersection to lights.
- Do not need closest intersection, can quit after one.
- Colors in shadows?

False Self-intersections

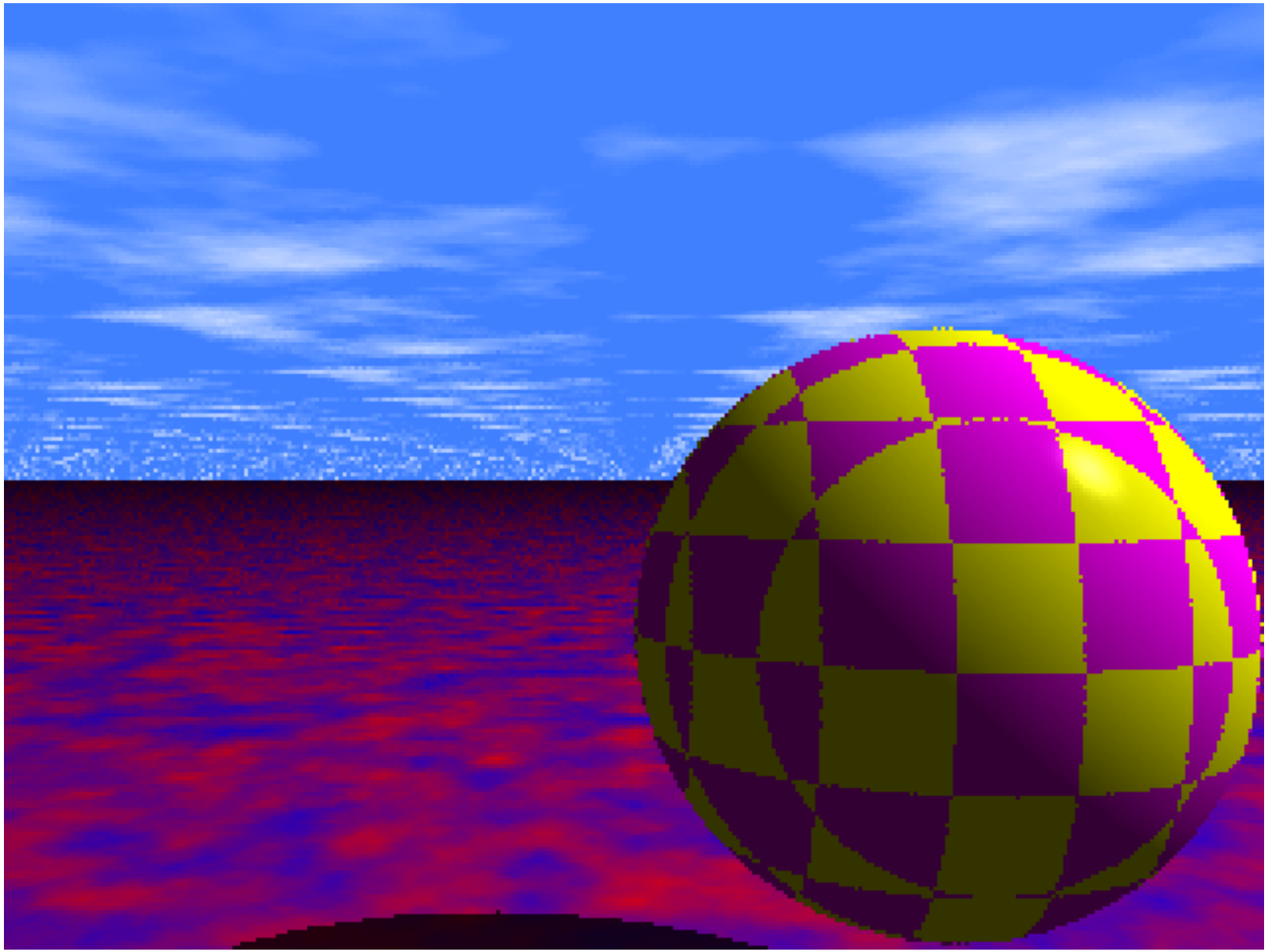


- Numeric problems with intersections.

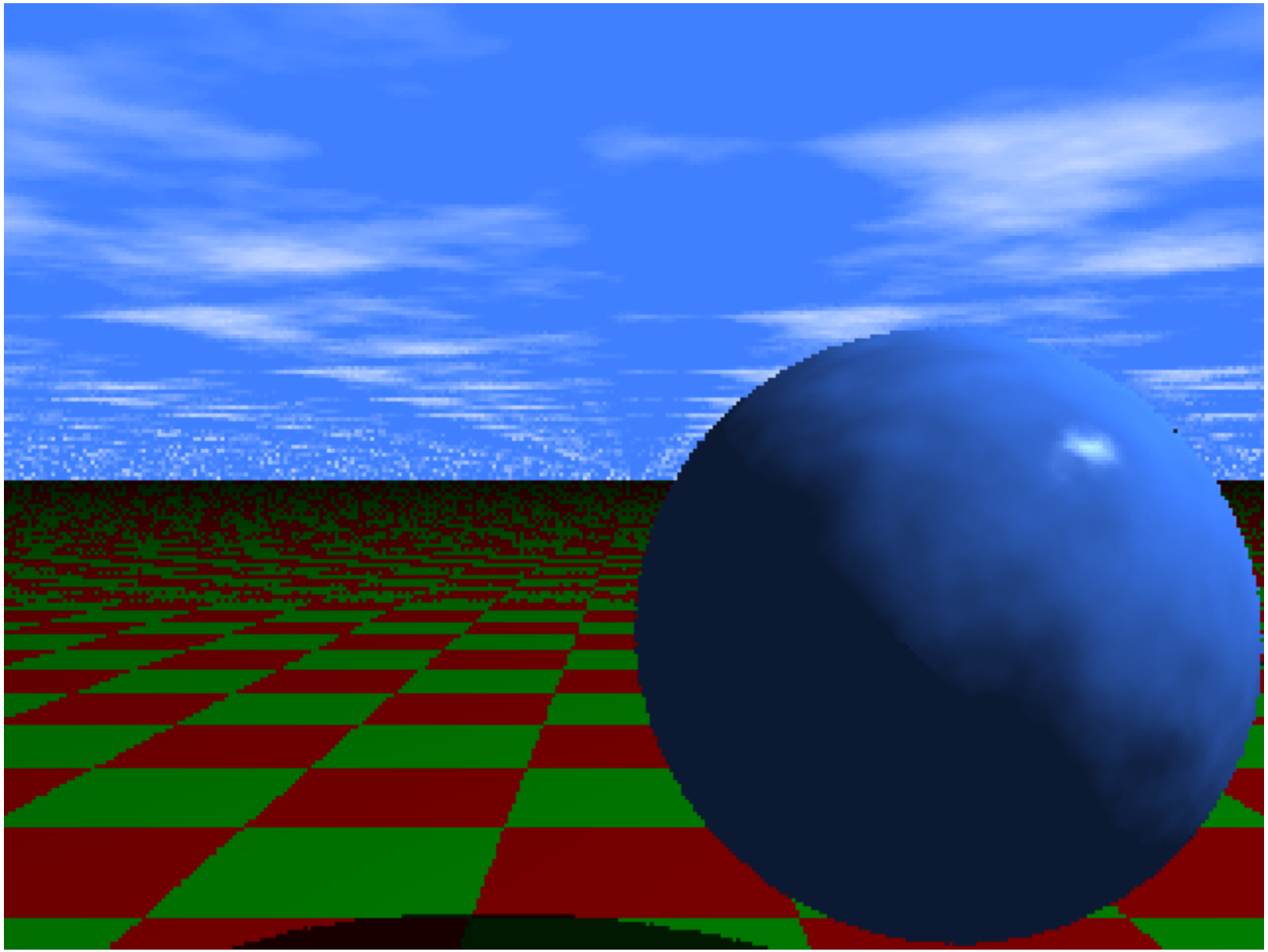
Noise texture



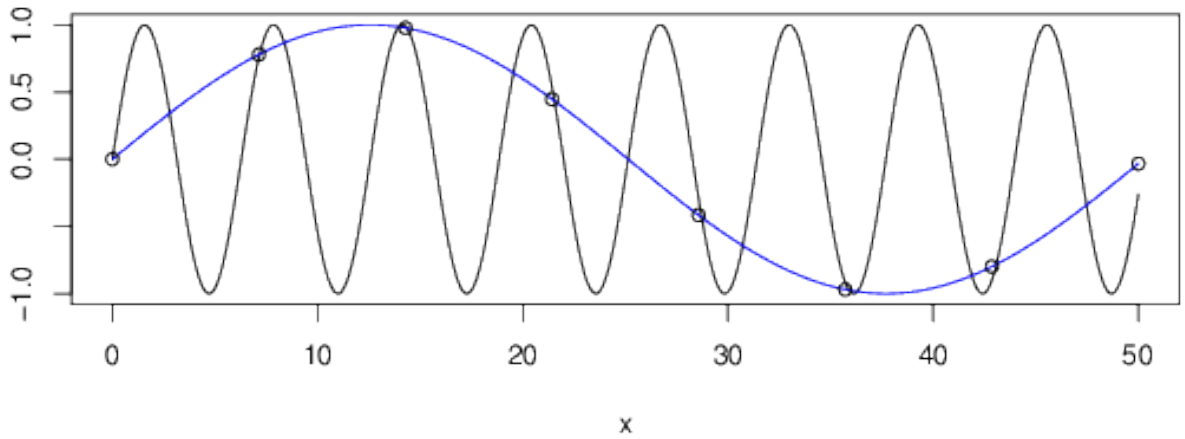
Alternate scene



Noise texture bumpmapped

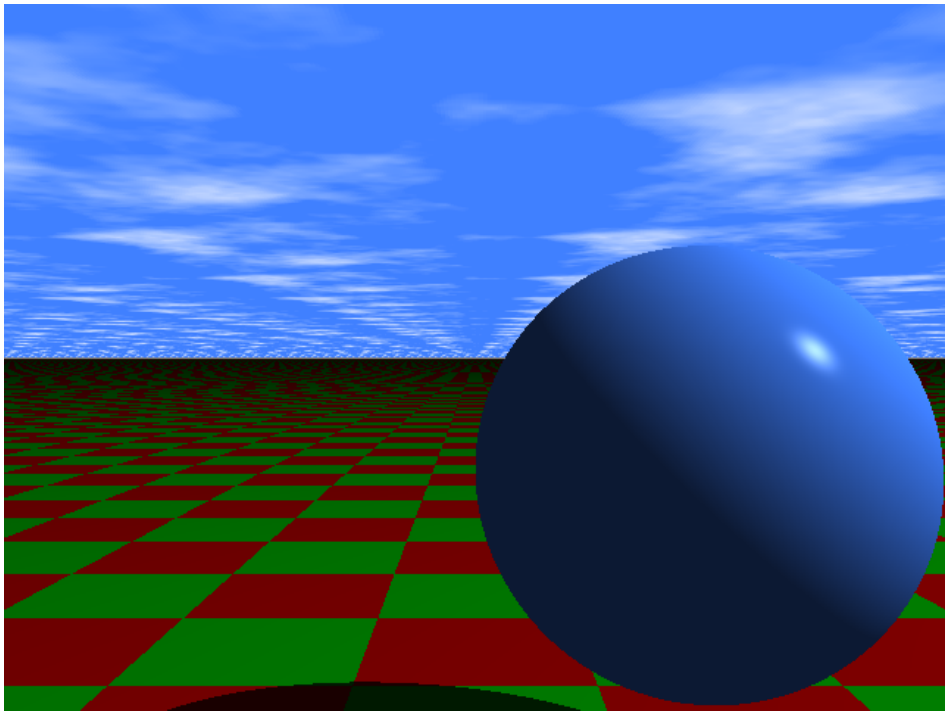


Aliasing



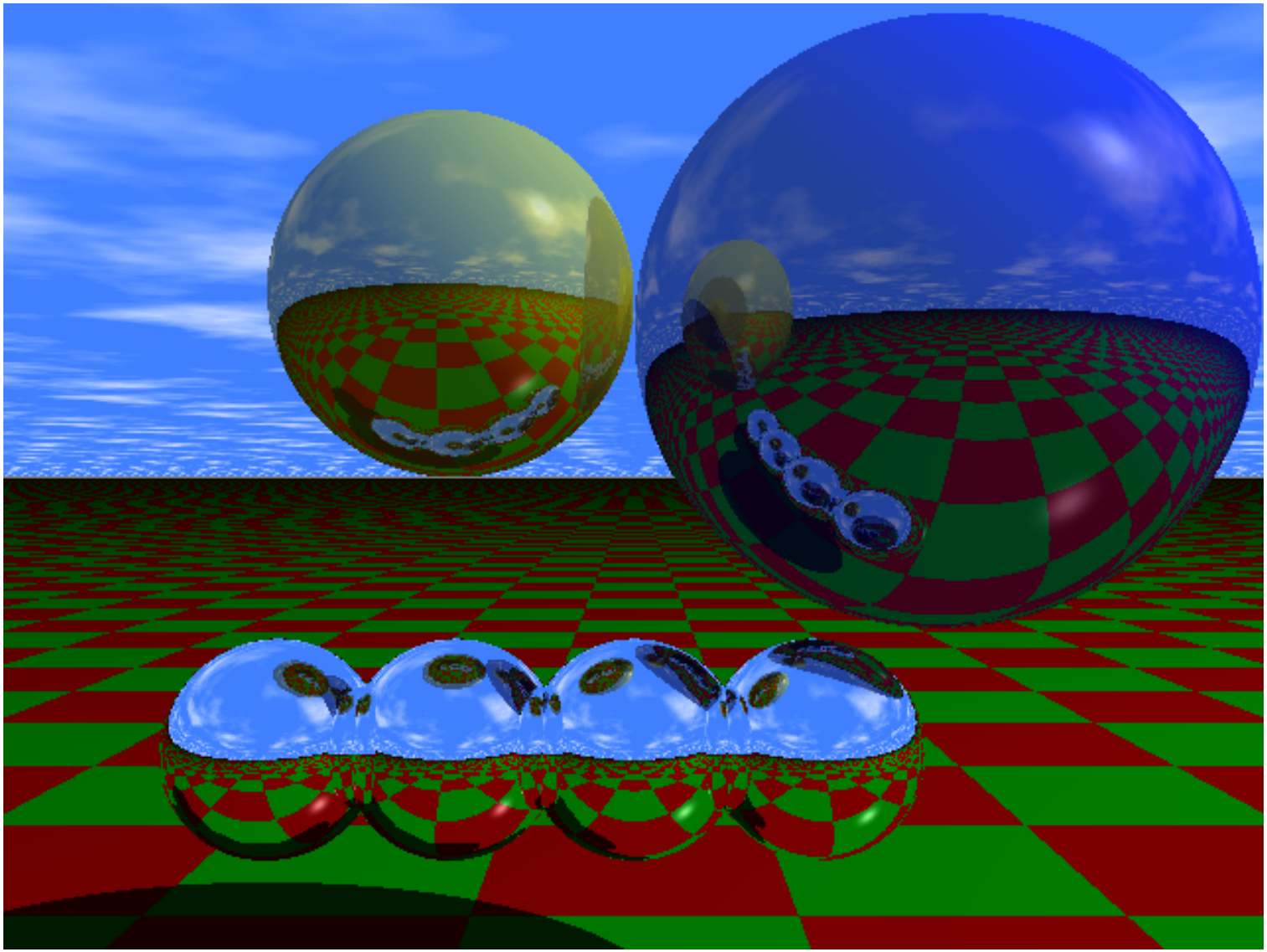
- Sample the black line at widely spaced gaps.
- Smoothly connecting the samples gives a signal of a much longer wavelength.
- The high frequency signal is masquerading, or **aliased** as a low frequency signal.
- All computer graphics is done at **pixels**, which are regularly spaced **samples**. *Pixels are not little squares!*
- Aliasing is a constantly recurring problem in computer graphics.

Aliasing in the simple scene

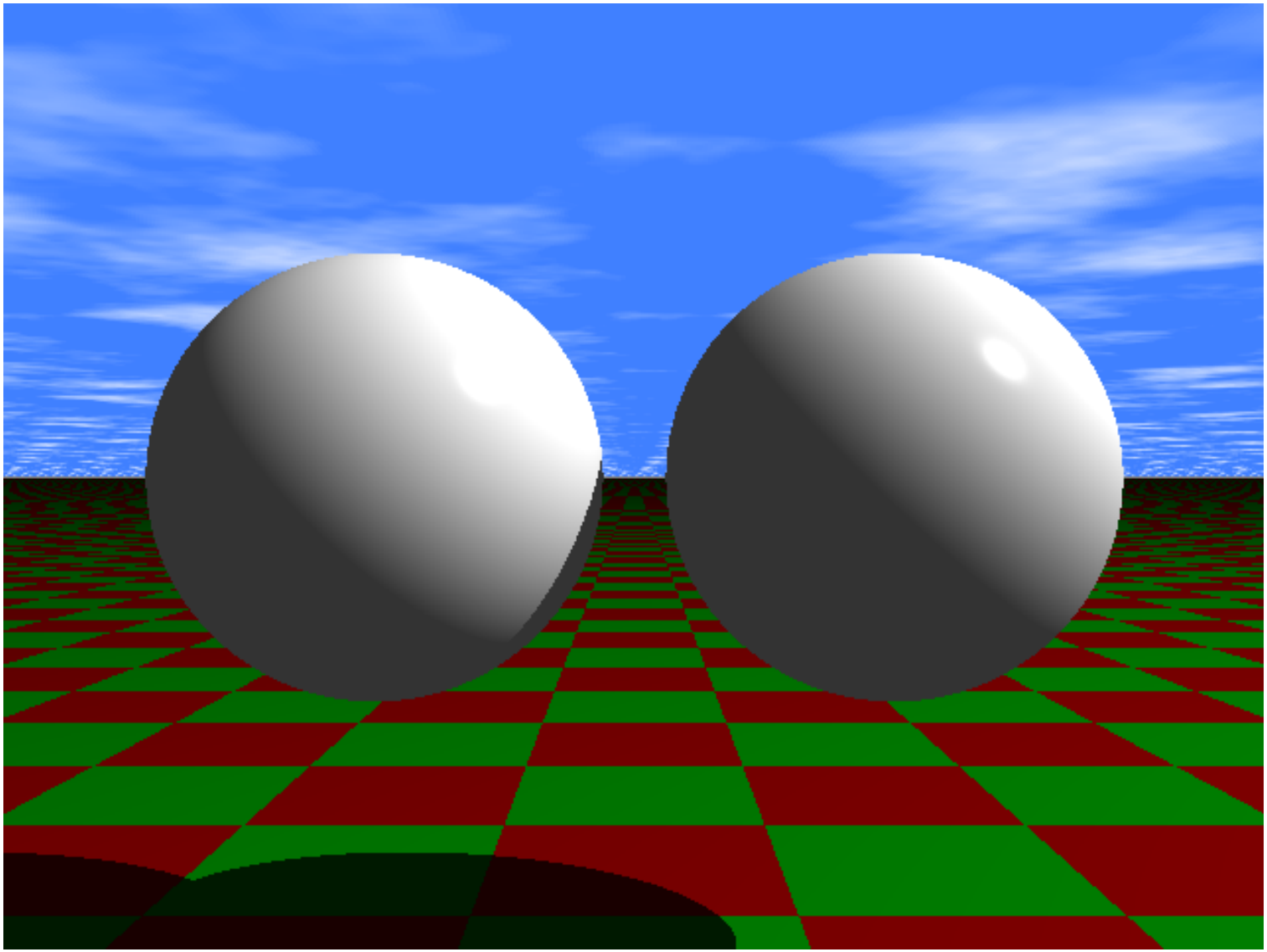


- Some visible artifacts
  - Jaggies on the edge of the sphere.
  - Large patches of color on the ground.
  - New patterns in the distant clouds.
- Some solutions to aliasing
  - Sample at random points in pixel area.
  - Resample multiple points in the pixel area.

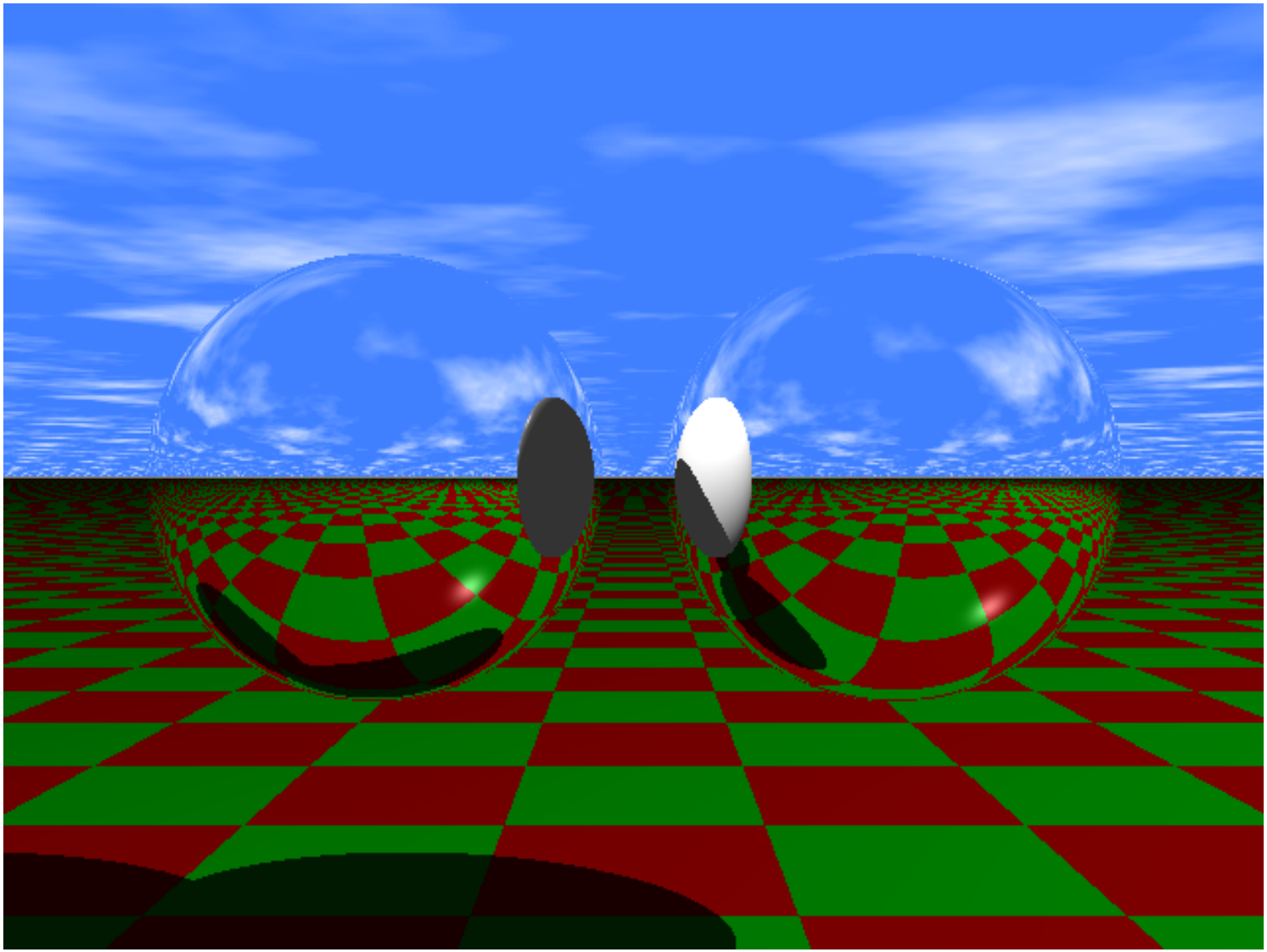
Reflections: Whitted Raytracing



Reflections: Recursion Limit



Reflections: Recursion Limit



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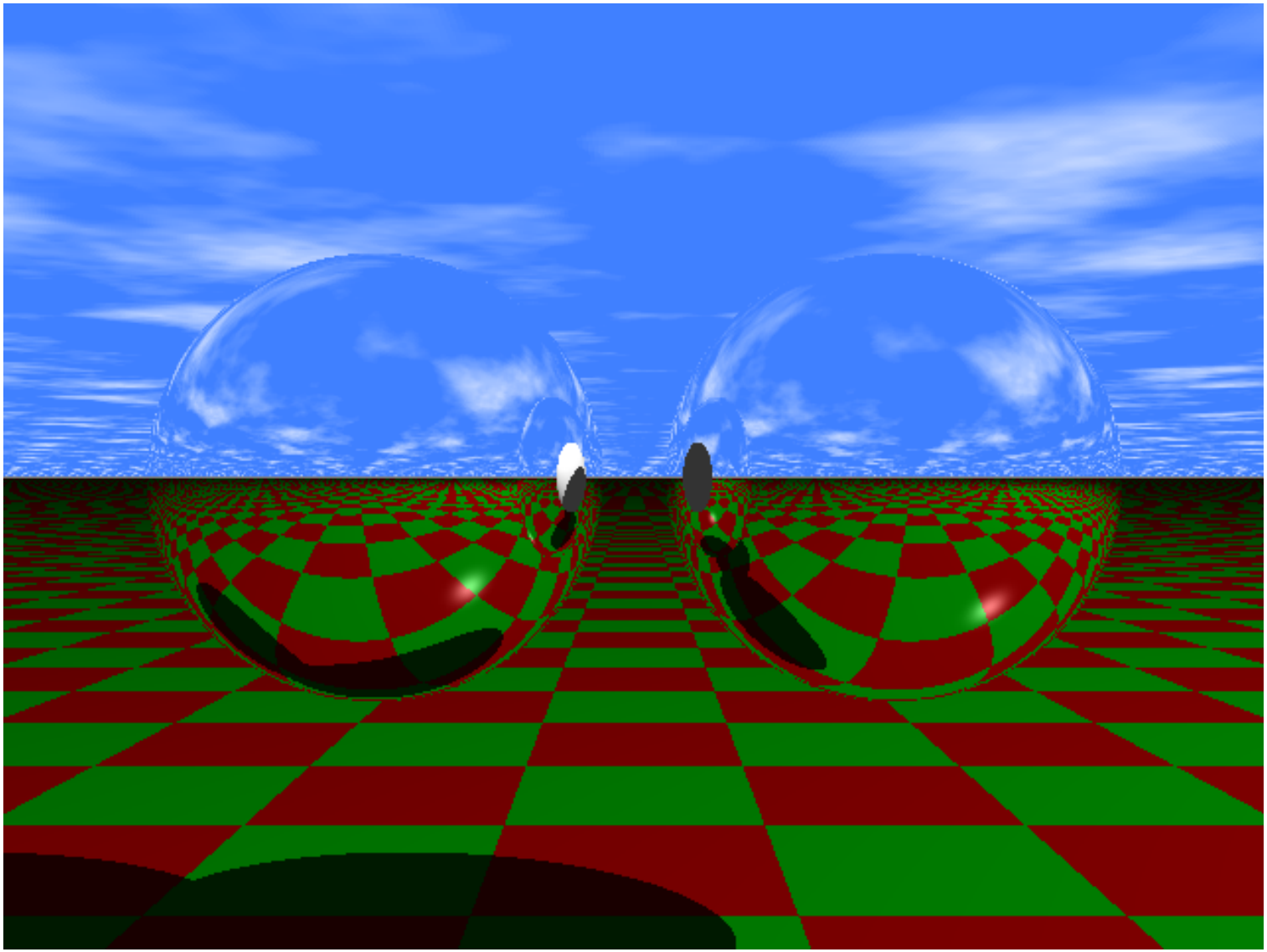

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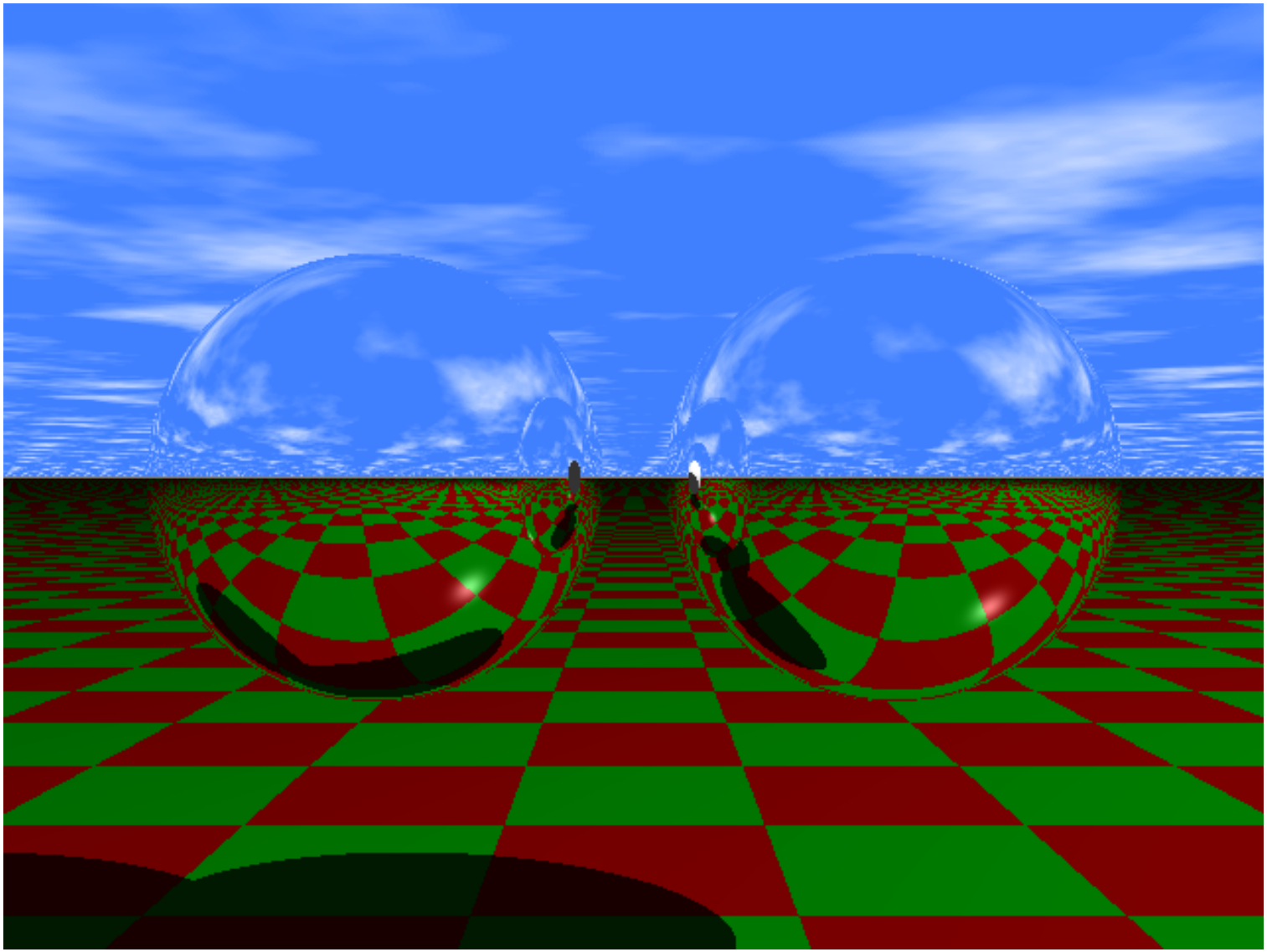

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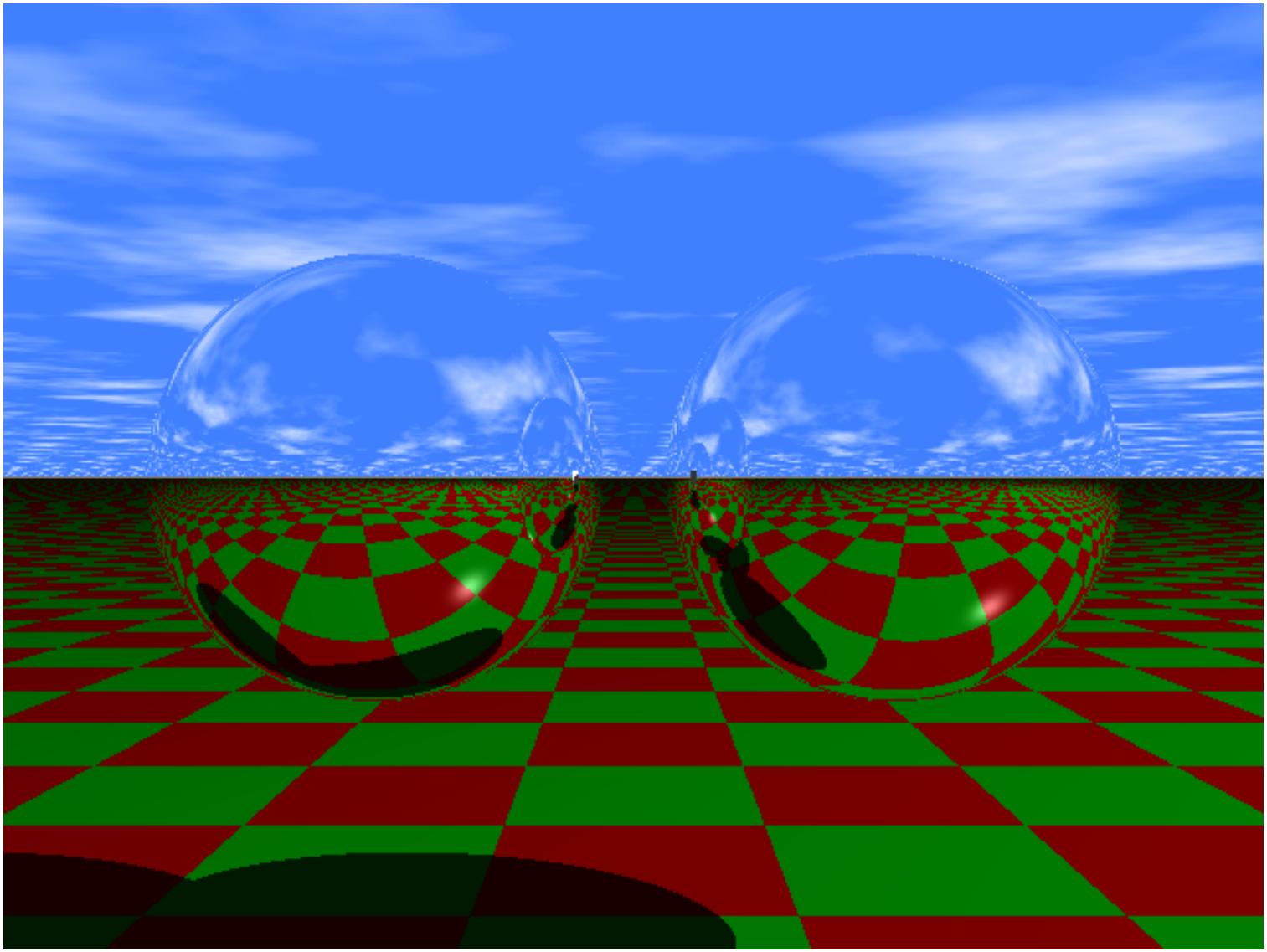

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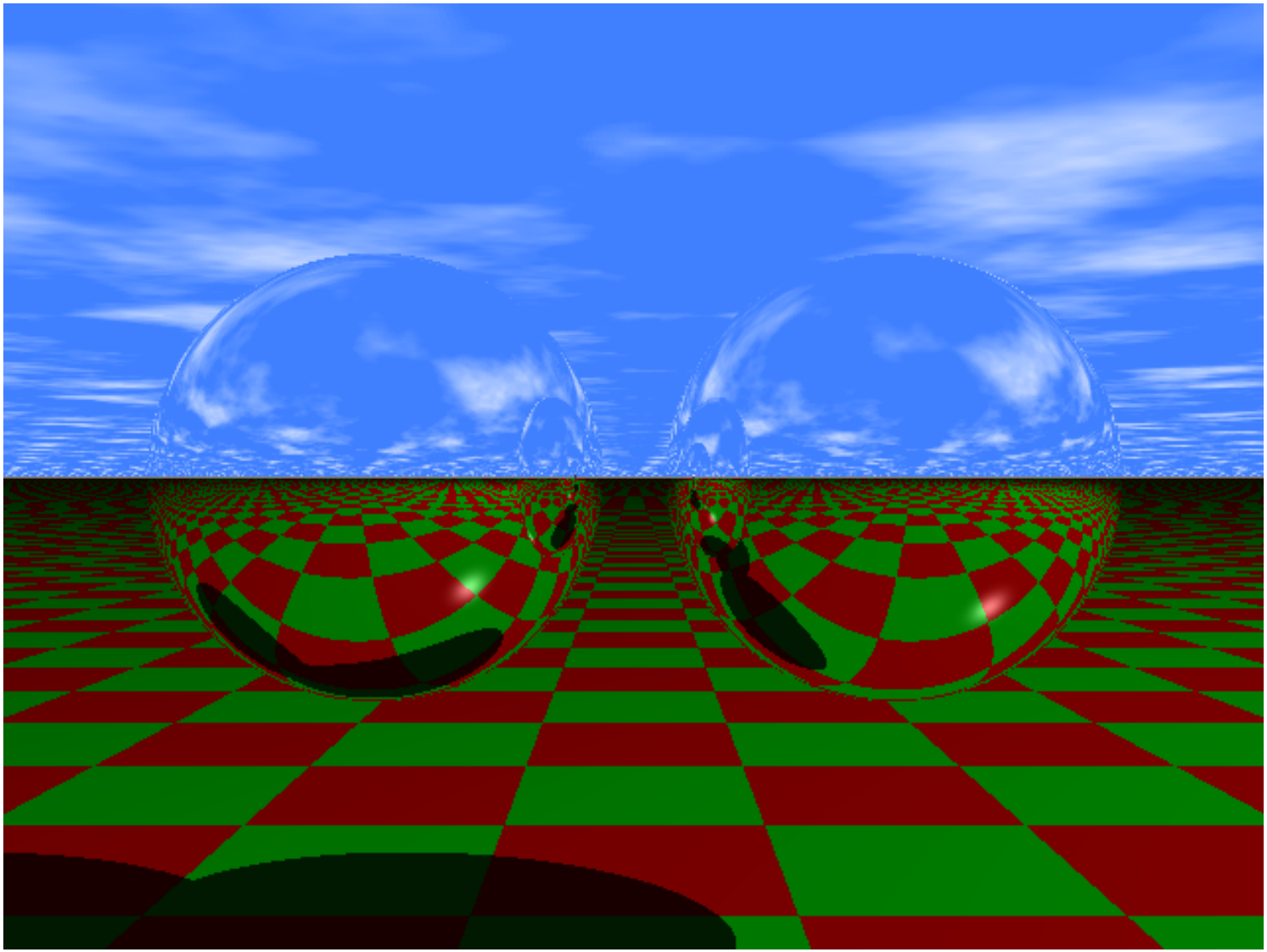

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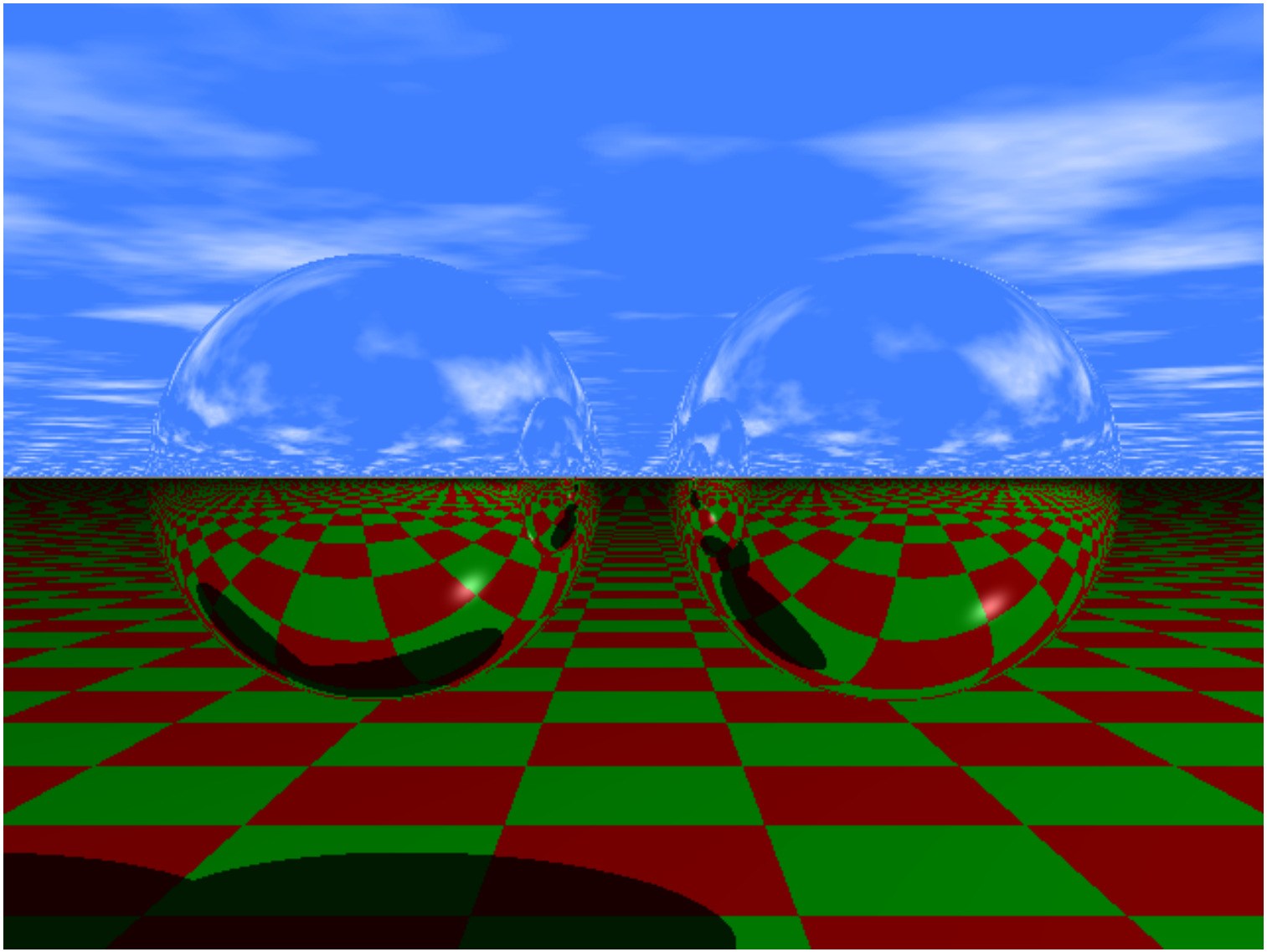
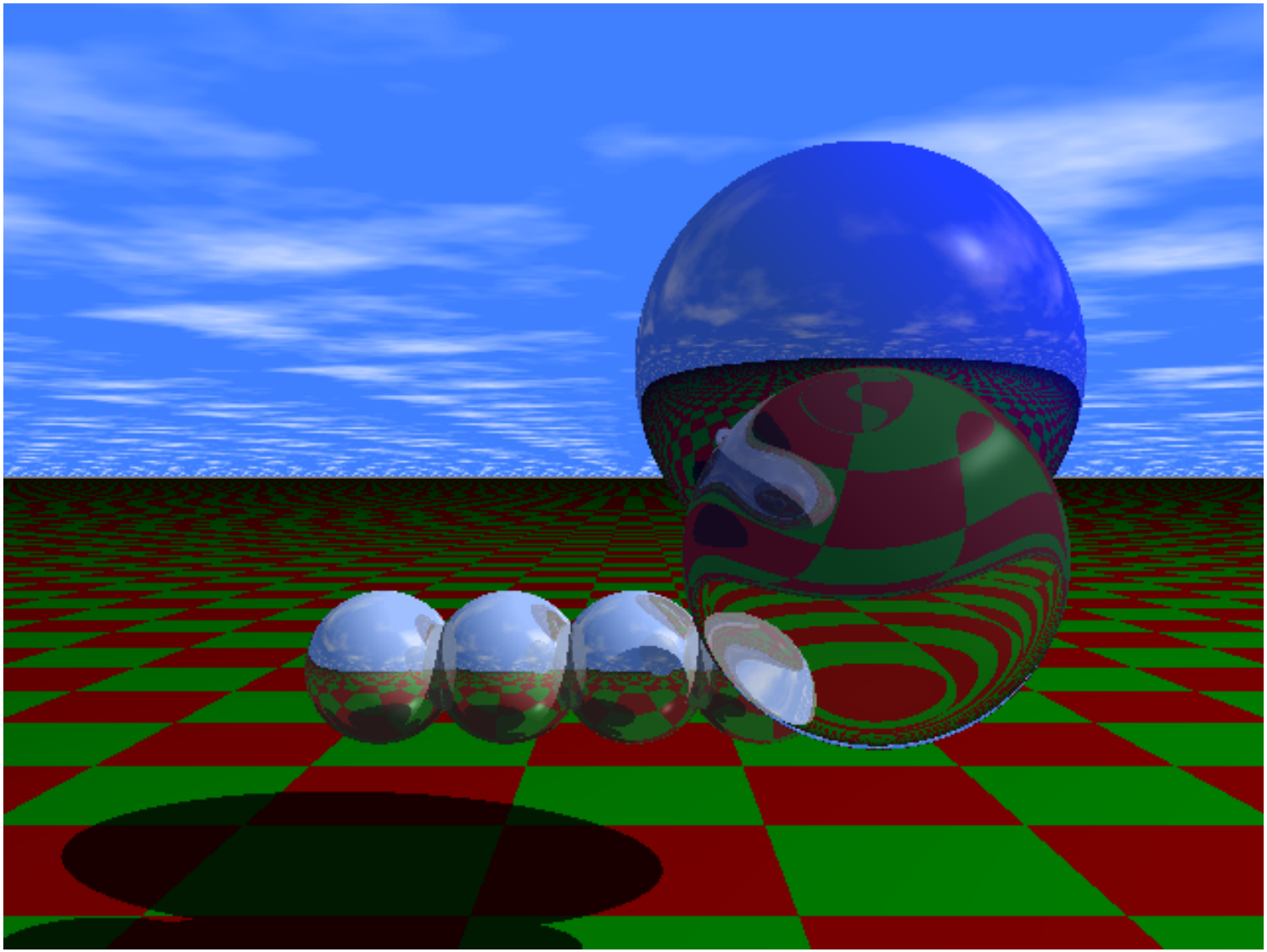
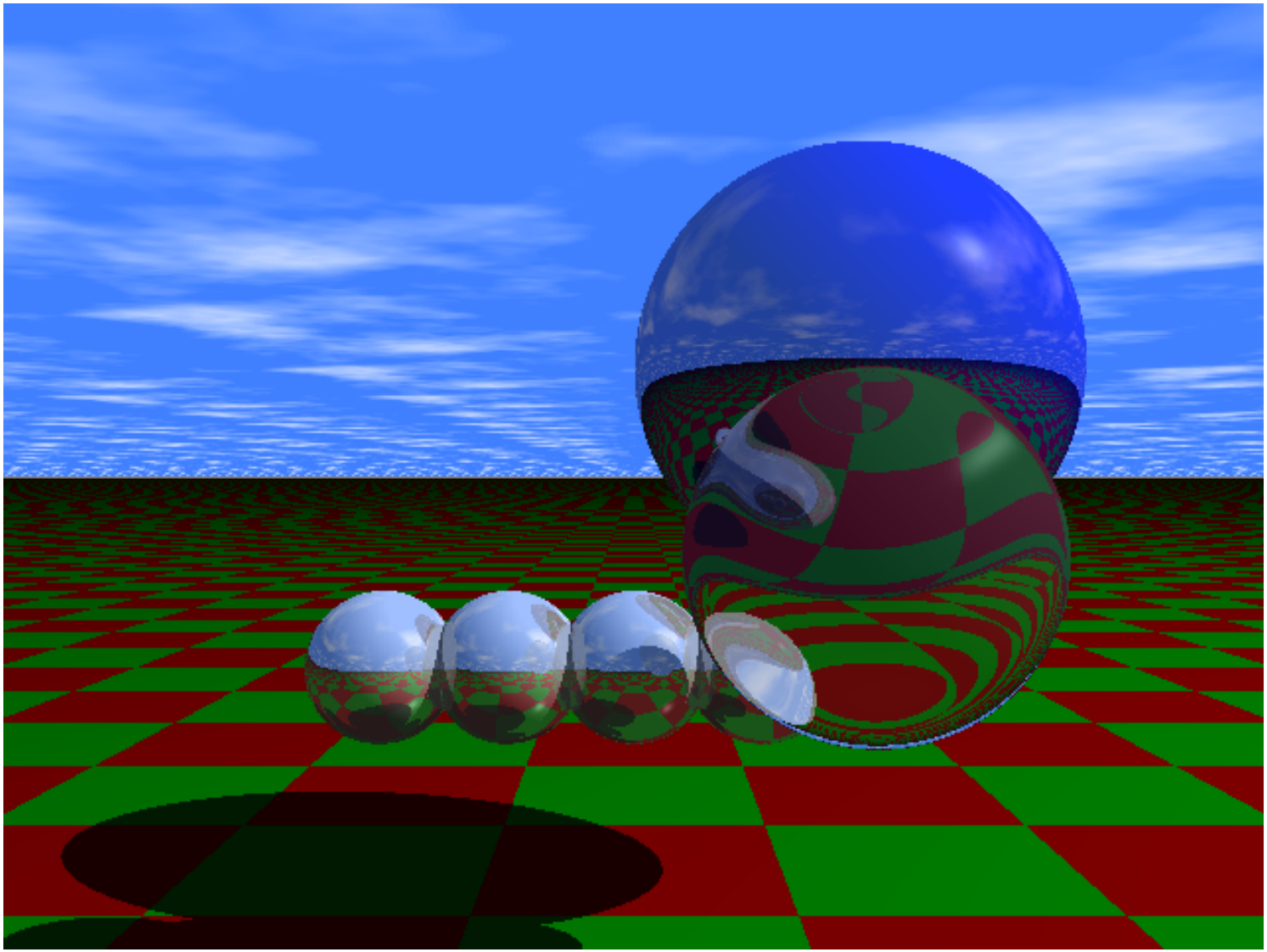


Refractions: Whitted Raytracing

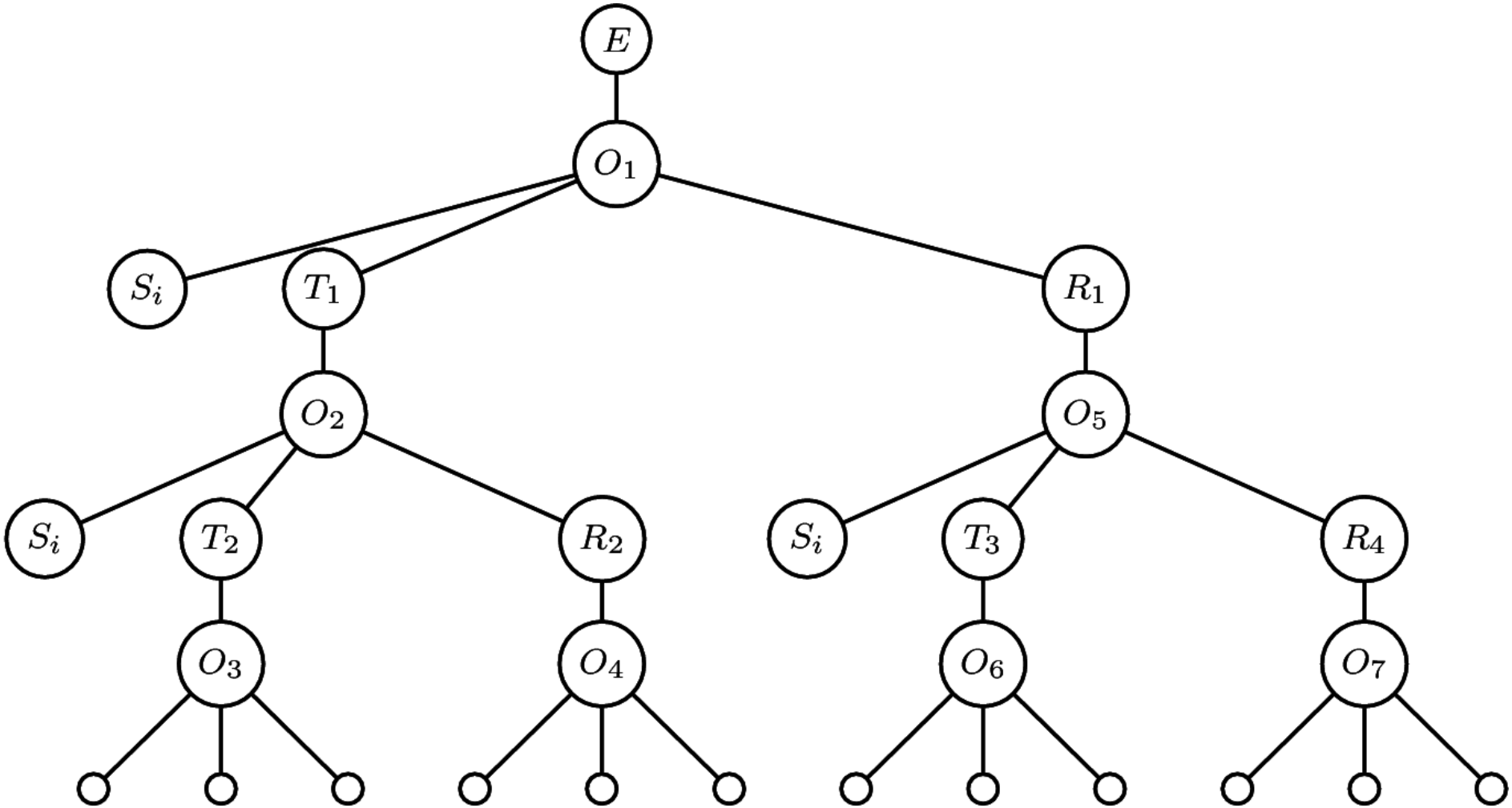


Refractions: Whitted Raytracing



- What about shadows if the object is transparent? Caustics?

The Ray Tree



Speeding up ray tracing

- Embarassingly parallel
- Object partitioning

Readings

- http://scratchapixel.com/lessons/3d-basic-lessons/lesson-1-writing-a-simple-raytracer/
- http://en.wikipedia.org/wiki/Ray_tracing_(graphics)
- http://www.cs.unc.edu/~rademach/xroads-RT/RTarticle.html
- http://en.wikipedia.org/wiki/Phong_lighting
- http://www.wiziq.com/tutorial/162719-6-837-7-Ray-Tracing-Computer-Graphics
- http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/

Software:

- http://pbrt.org/
- http://www.luxrender.net/en_GB/index
- http://www.povray.org/
- http://www.yafaray.org/
- http://radsite.lbl.gov/radiance/HOME.html
- http://www-graphics.stanford.edu/~cek/rayshade/rayshade.html