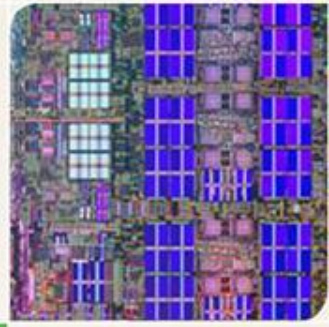
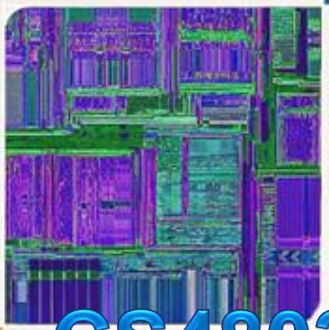



CS4803DGC Design and Programming of Game Consoles

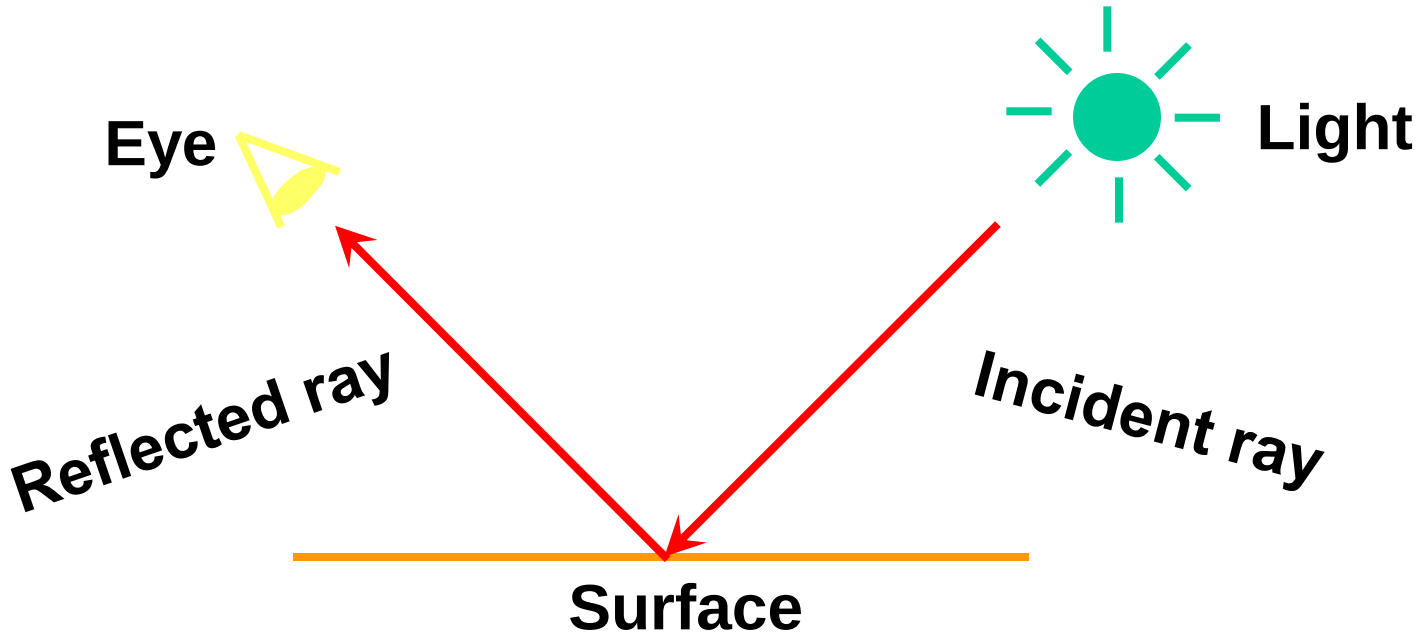
Spring 2011

Prof. Hyesoon Kim

Georgia Tech College of Computing

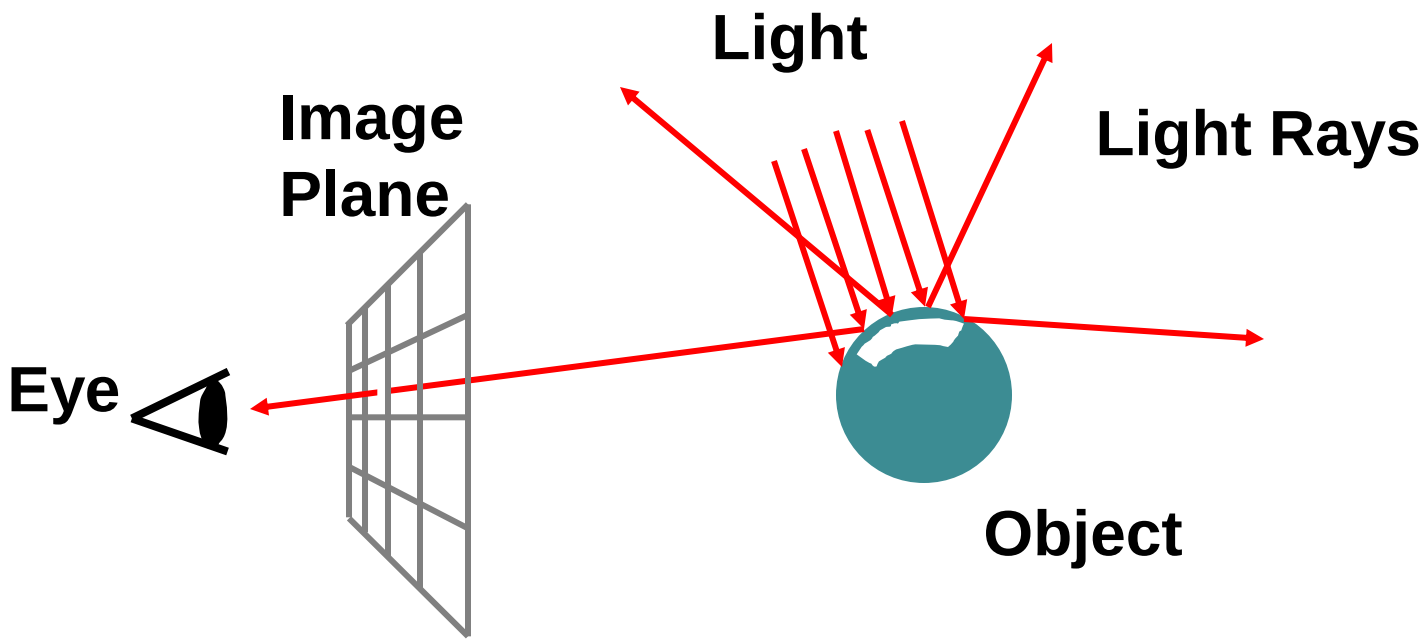
Ray Tracing Problem

- What is it?
  - Simulate light rays from light source to eye



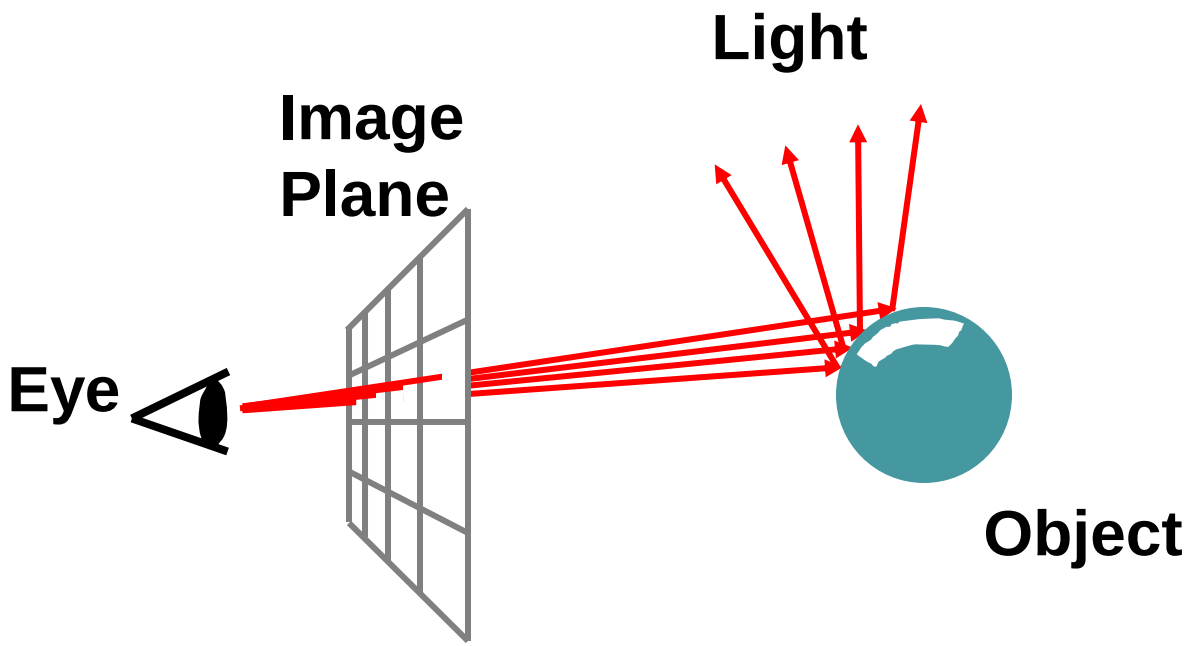
"Forward" Ray Tracing

- Trace rays from light
- Lots of work for little return

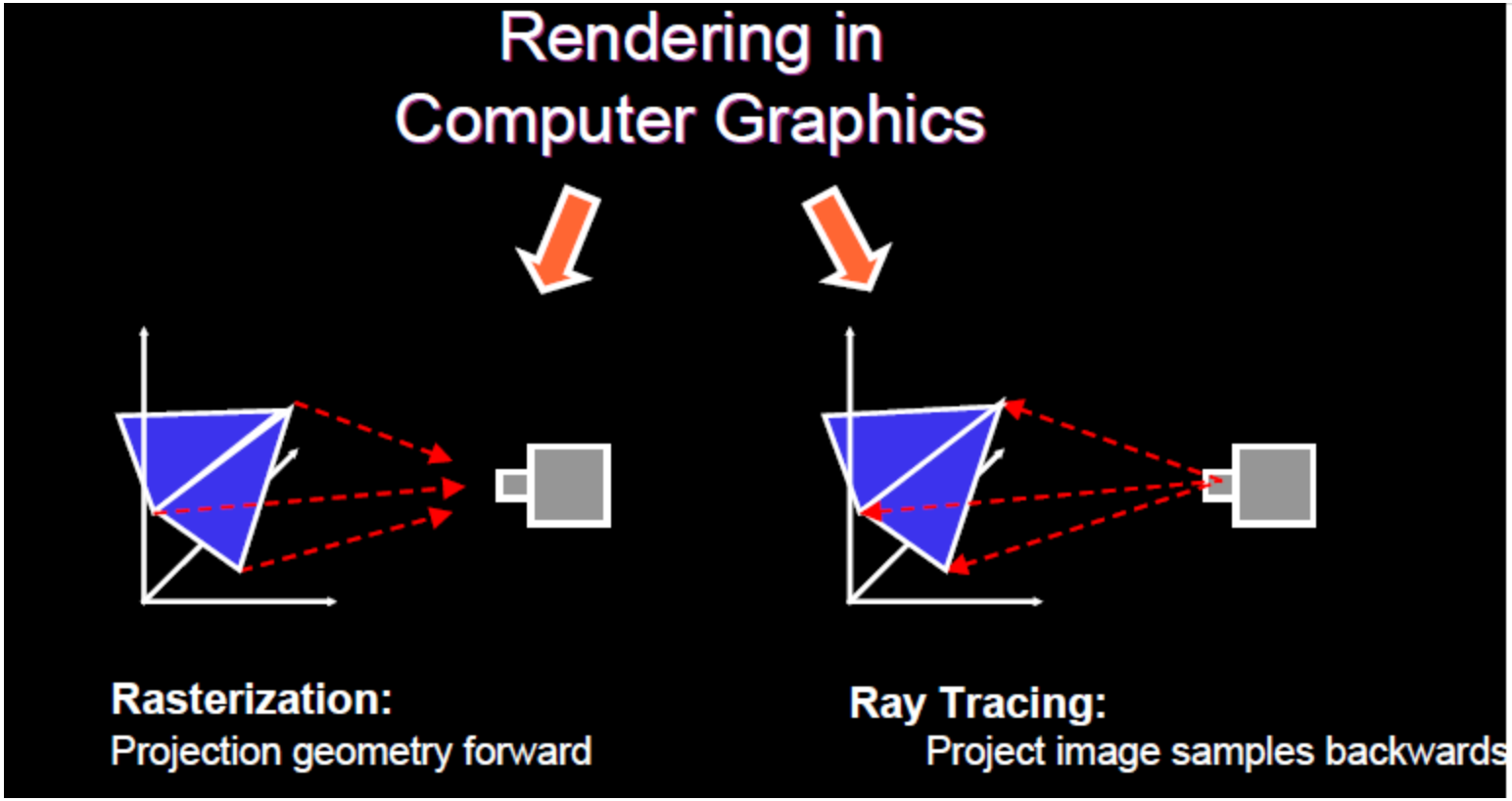


"Backward" Ray-Tracing

- Trace rays from eye instead
- Do work where it matters



This is what most people mean by "ray tracing".


Rendering in
Computer Graphics
Rasterization:
Projection geometry forward
Ray Tracing:
Project image samples backwards

Ray-Tracing Algorithm 101

- 1) construct ray from camera through pixel

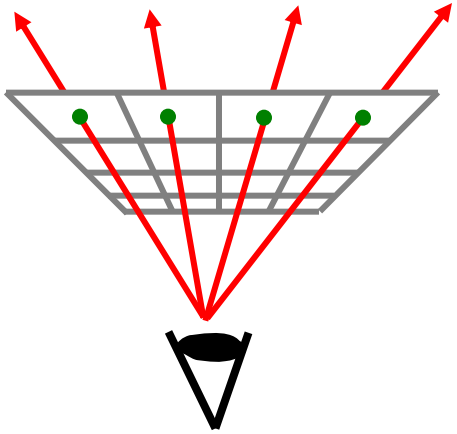
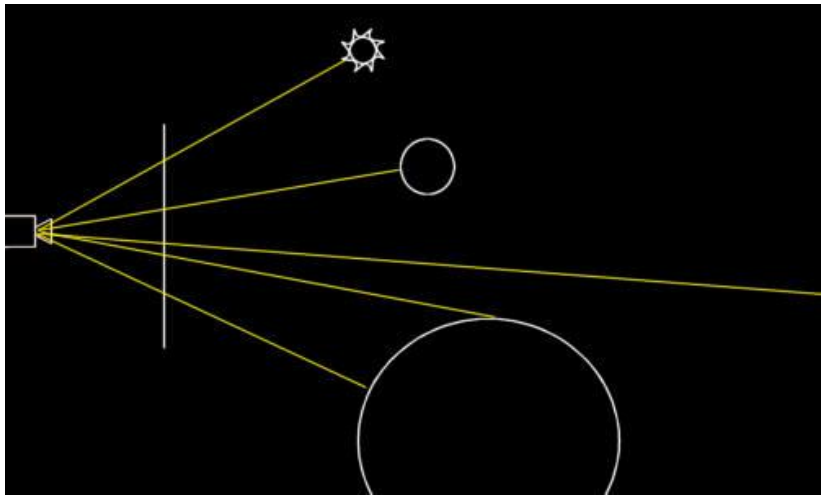
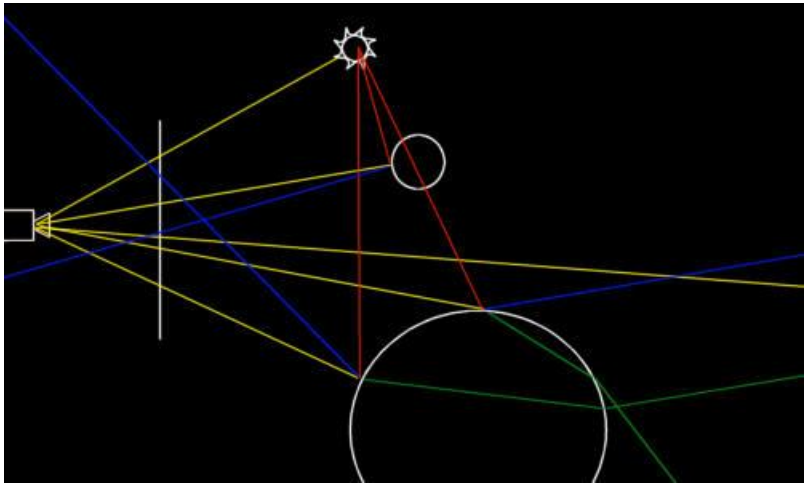


Image Plane

- 2) Find first primitive hit by ray
- 3) Determine color at intersection point
  - Simple diffuse shading,
- 4) draw color

Primary vs. Seconday Rays



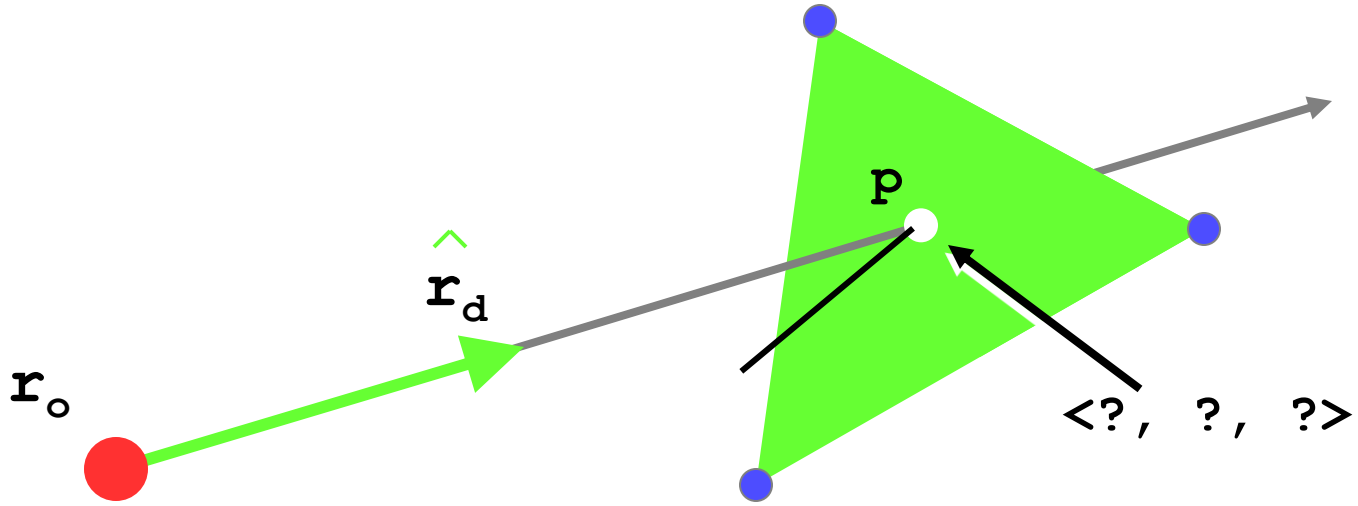


Blue: reflected rays
Green: refracted rays
Red: light source (useful for occlusion, shadow)

http://www.devmaster.net/articles/raytracing_series/part2.php

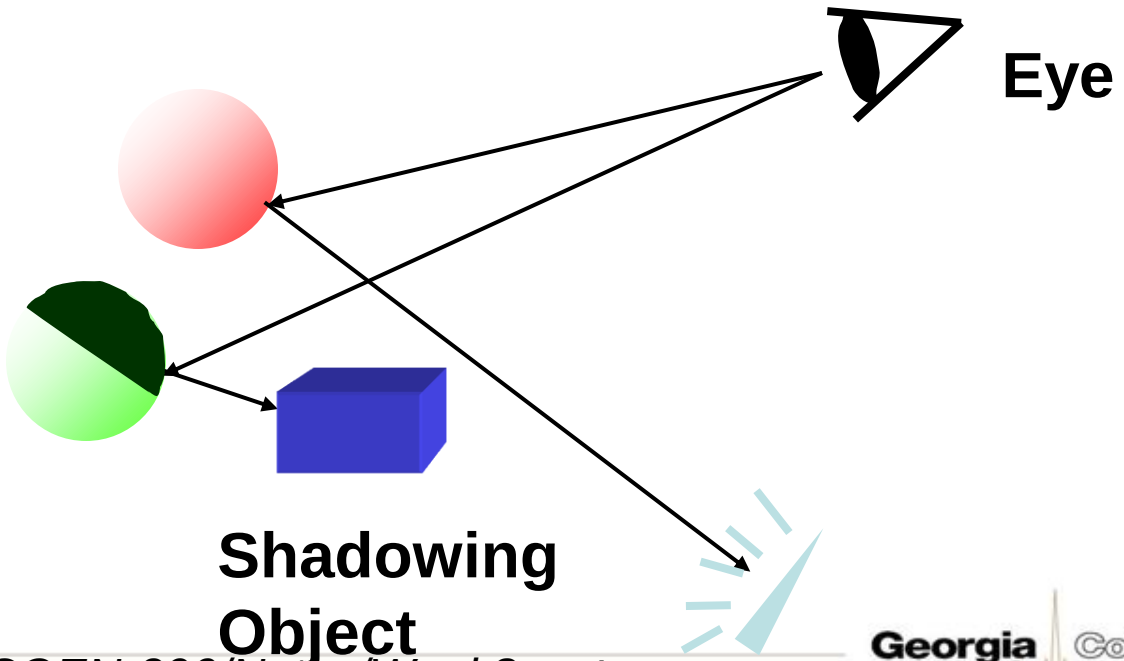
Triangle Intersection

- Want to know: at what *point* (p) does ray intersect triangle?
- Compute lighting, reflected rays, shadowing *from that point*



Shadow Test

- Check against other objects to see if point is shadowed





Lab #3: Improving Ray Tracing

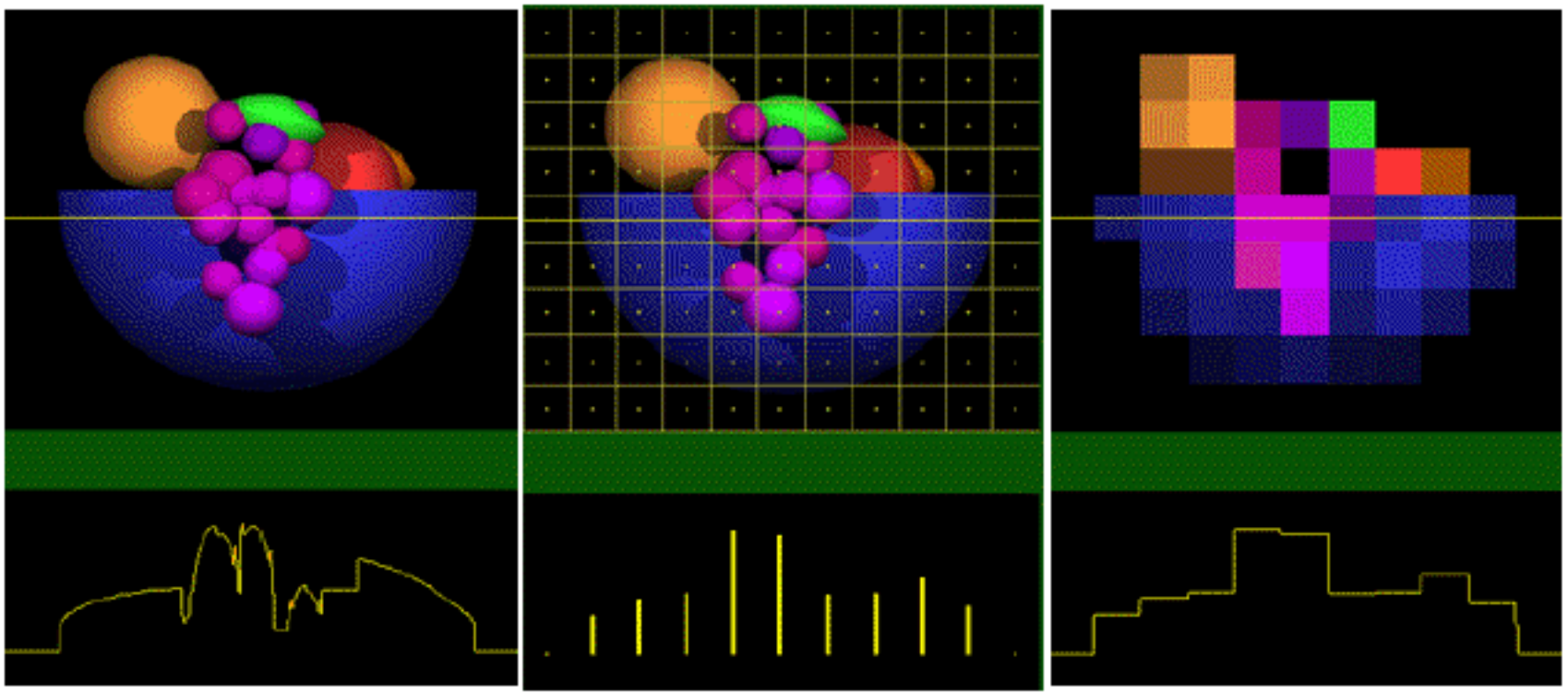
- http://cg.alexandra.dk/2009/08/10/triers-cuda-ray-tracing-tutorial/



Display with CUDA

- CUDA + openGL
- “postProcessGL” SDK example shows a good example
- Simply,
  - Create a PBO (Pixel buffer object) using openGL
  - Render the scene to the framebuffer
  - Copy the image to a PBO
  - Map POB so that it’s accessible from CUDA
  - CUDA process data
  - Copy PBO to a texture
  - Display the texture.

Examples of Aliasing

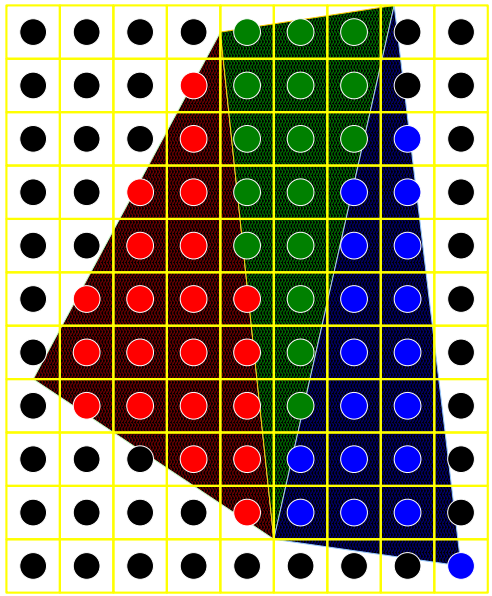


- Aliasing occurs because of *sampling* and *reconstruction*

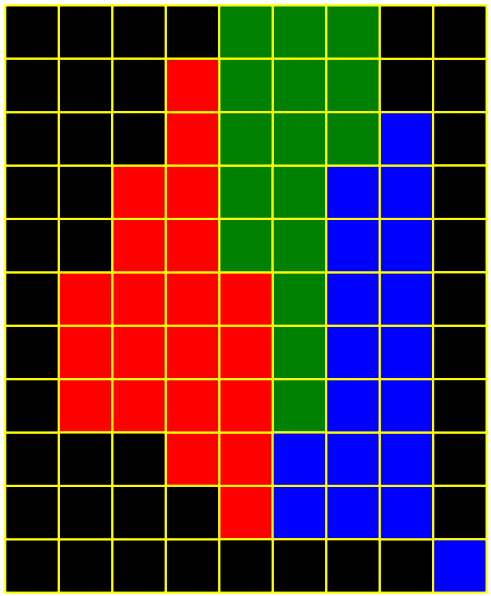
Source: groups.csail.mit.edu/graphics/classes/6.837/F04/lectures/13_aliasing.**ppt**

Anti-Aliasing

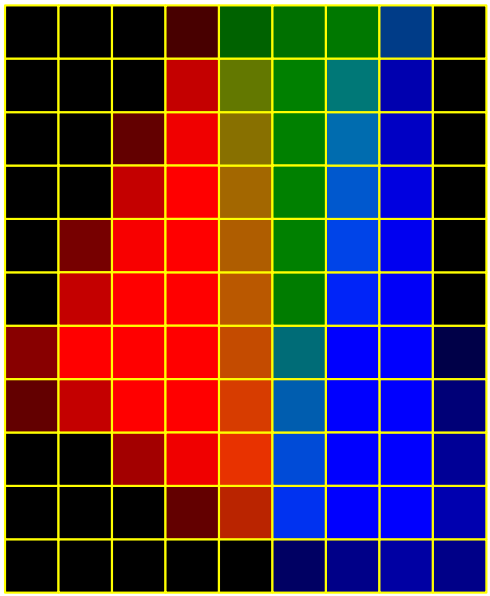
- Aliased rendering: color sample at pixel center is the color of the whole pixel
- Anti-aliasing accounts for the contribution of all the primitives that intersect the pixel



Triangle Geometry



Aliased



Anti-Aliased



Assignments

A group project: 2 people

Provide an example code of ray tracing

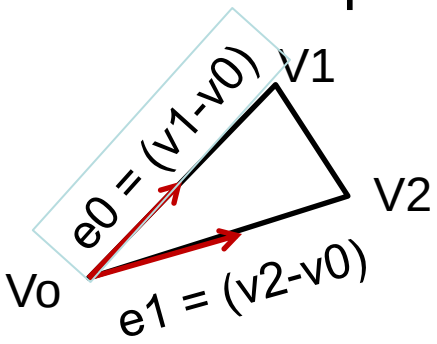
(1)implement one anti-aliasing algorithm and compare the results

- supersampling

(2) To-be-announced

main.cpp

- Load images into Texture memory
  - Stores edges instead of vertex points to save some calculations



- OpenGL setup
- PBO (Pixel buffer object)
- I/O (setting up camera position, light source etc.)
  - AntTweakBar library provides the APIs

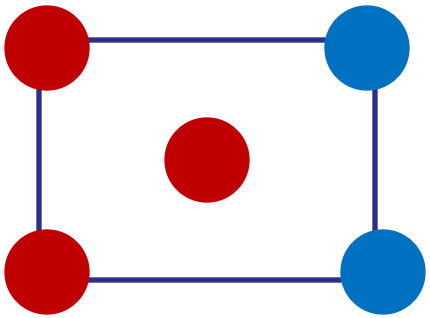


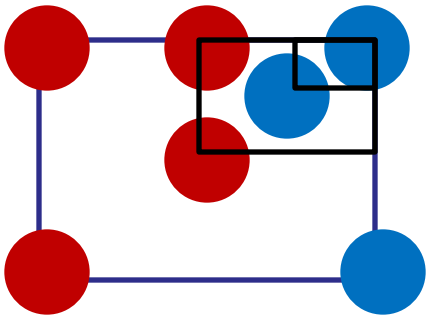
raytracer.cu

- RayTraceImage: interface with C
  - blocksize (8,8,1)
- raytrace
  - Each thread (different image pixel)
  - Calculate ray (origin, direction)
  - Ray sphere intersection, (search the nearest hit point) : traverse all triangle
  - Continue the light (depth level 4) until the light is out of the screen
  - Calculate simple diffuse and secular light
  - Shadow light
    - Create a shadow ray
    - Check whether there is a blocker on the path or not, it is then make it darker
- HitRocord contains color and normal vector and store out_data (PBO pointer)

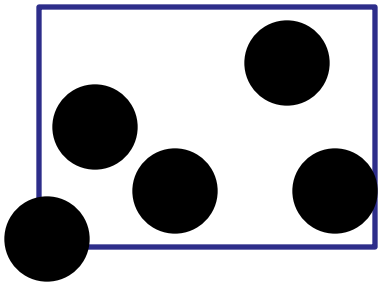
Anti-aliasing with Super Sampling

- More than one array per pixel
- Average the results





adaptive



Stochastic

- Adaptive sampling (increase the resolution based on the color differences)
- Stochastic sampling: Instead of regular grid, random subgrid



Suggesting Anti-aliasing Implementation

- Create more rays
  - How? (naïve super sampling, adaptive, stochastic)
  - Recalculate xf, yf
  - Repeat all the computation
  - Average the values before out_data



Performance Issues

- Ray tracing pipeline
- Ray generation→ Intersection →closest hit shade
- Traverse requires finding closest primitives
- Source of performance degradations
- Optimizations:
  - Better data structures, (KD-tree, BVH (Bounding Volume Hierarchy Data Structure))
  - Monte Carlo simulations
- Branch…