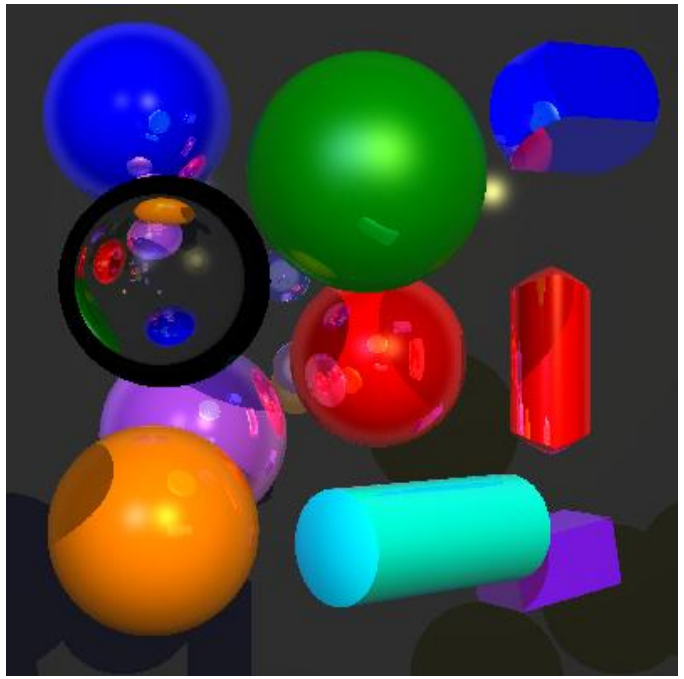
Lab Sessions

Photorealistic Rendering (Advanced Computer Graphics)

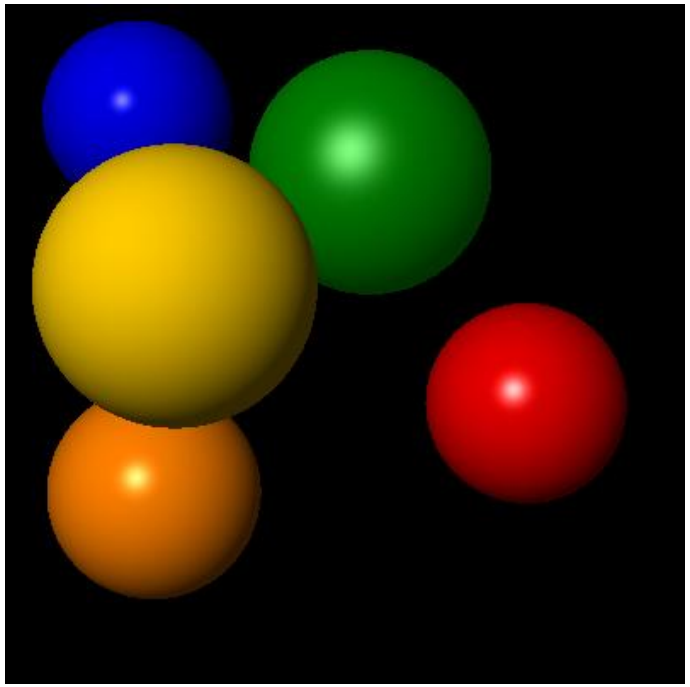
Tobias Isenberg

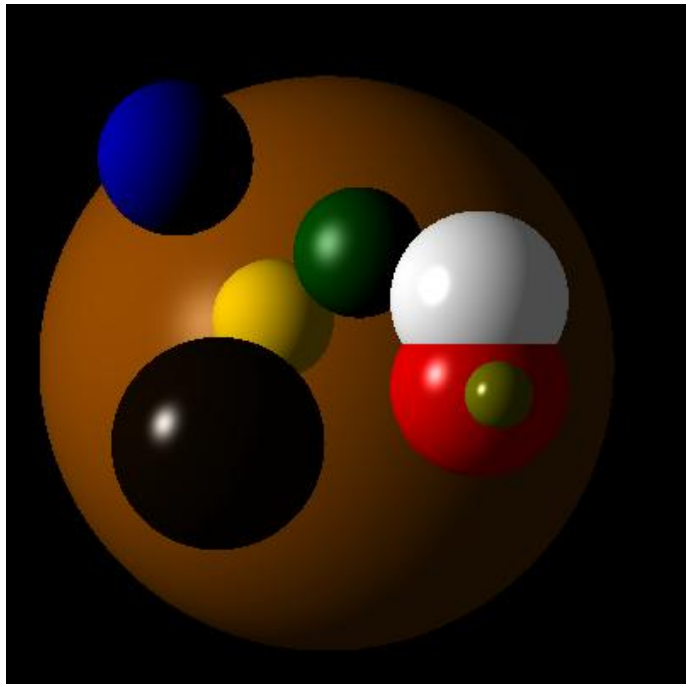
informatics mathematics Inria



Thanks for sending the assignments early

- most with correct results





Statistics of following instructions

- sending group composition: 4/6 groups 😐
- submitting on time: 6/6 groups (with short grace period) ☺
- correct e-mail subject: 3/6 groups 😐
- correct file name of archive: 1.9/6 groups (English spelling) 😐
- correct file type of downloaded archive: 6/6 groups ☺
- including all results images in a pictures folder: 4/6 😐
- including failure/error images: 1/6 ☹
- single script to produce the results: 4/6 😐

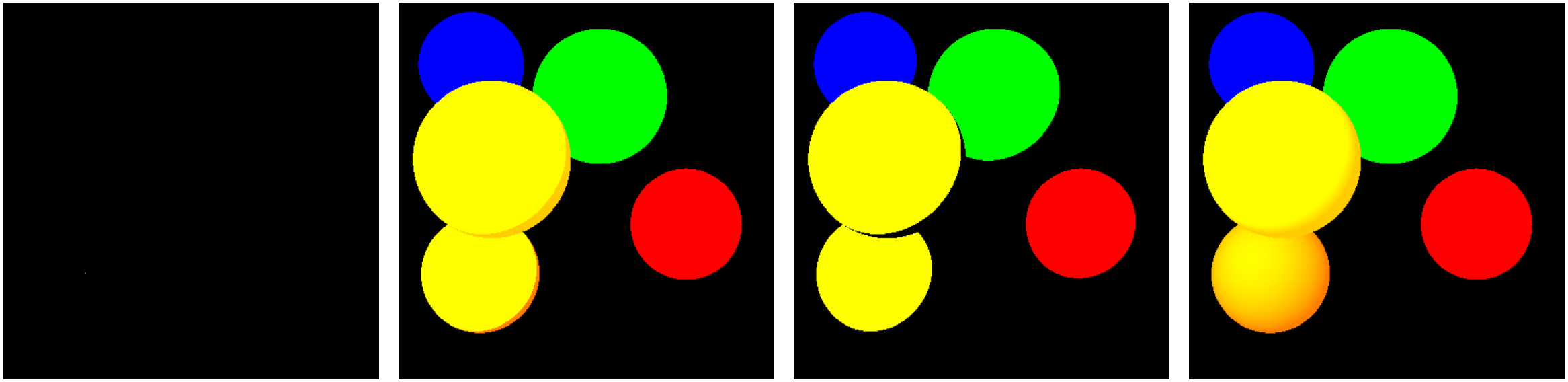
Instructions …

- revisit the instructions:
  - revisit the requested file structure
  - one single `runme.bat` that calls the compiler separately per image
  - from the `x64/` folder, only copy `raytracer.exe` in the `Release/` subfolder
    → differences between release and debug compilation
  - if multiple different compiler versions, rename the `exe` files
  - naming of the archive: `assignment1_Smith_Jones.zip`
- some other guidelines:
  - batch file should not overwrite images in the results folder
  - delete the `raytracer/` and `x64/` subfolders (object files, binaries)

Reminder: How to submit the assignments

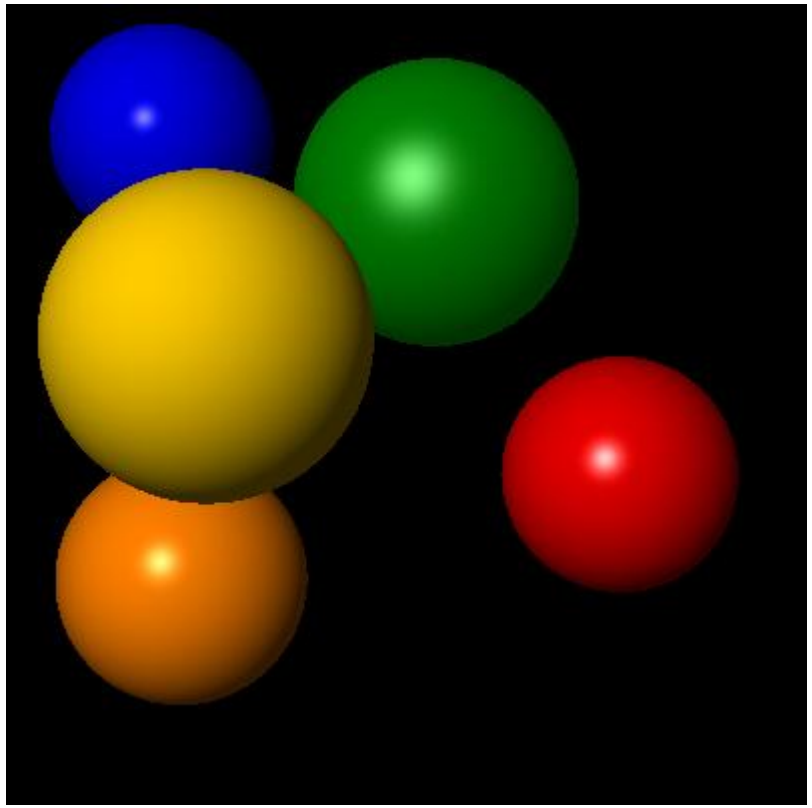
- **direct download** please
- archive should contain 3 directories
  - 1 source including **sln file**
  - 1 binary with *.exe and **script for all input files** but **no object files**
  - 1 with result images and potentially nice errors
- **subject line:** “[CG Assignment] Assignment X, Name & Name”
  - e.g., “[CG Assignment] Assignment 1, Smith & Jones”
  - not: “[Advanced CG class] First Assignement”
- **file name: assignment{1-7}_LastName_LastName.{zip|7z}**

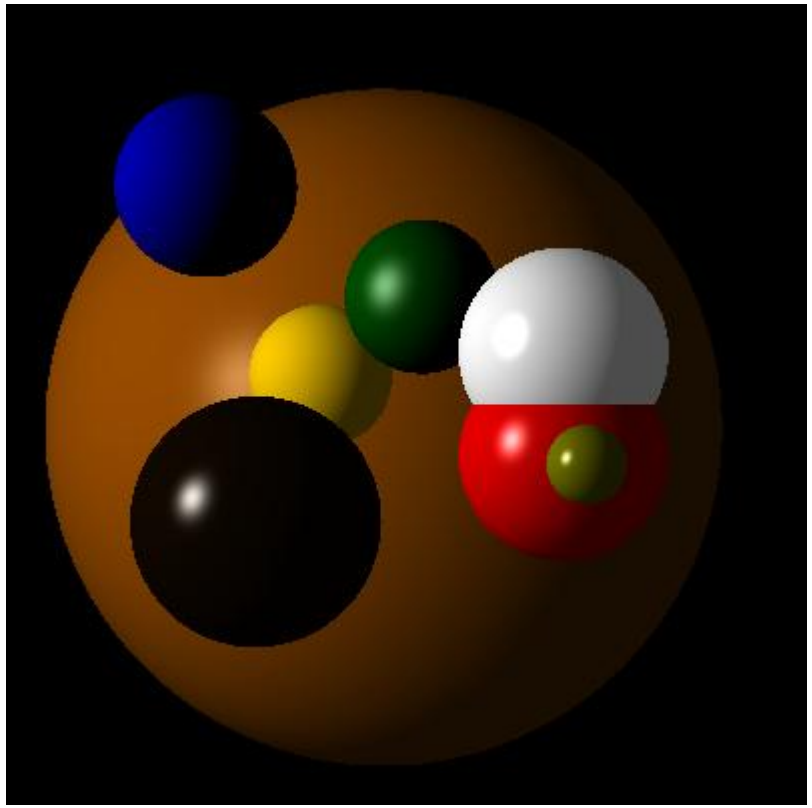
Actual problems



Possible problems

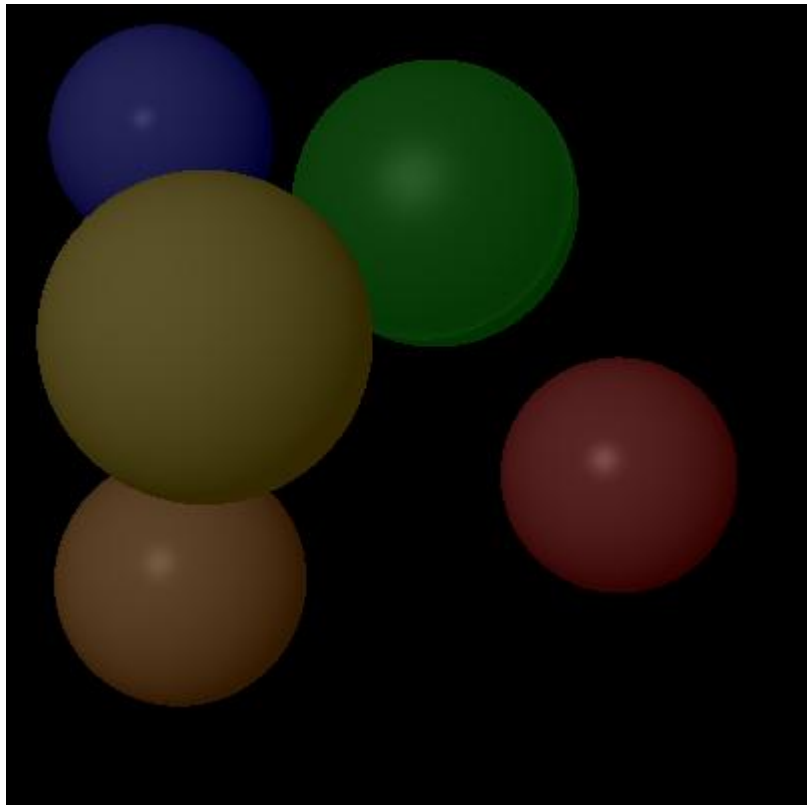
- intensity of diffuse and ambient

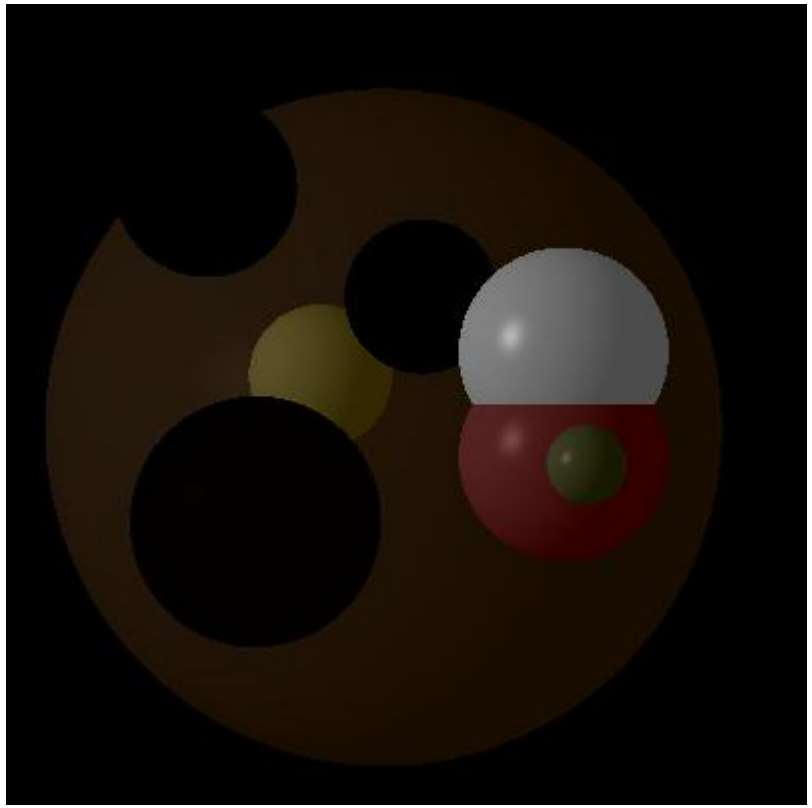




Possible problems

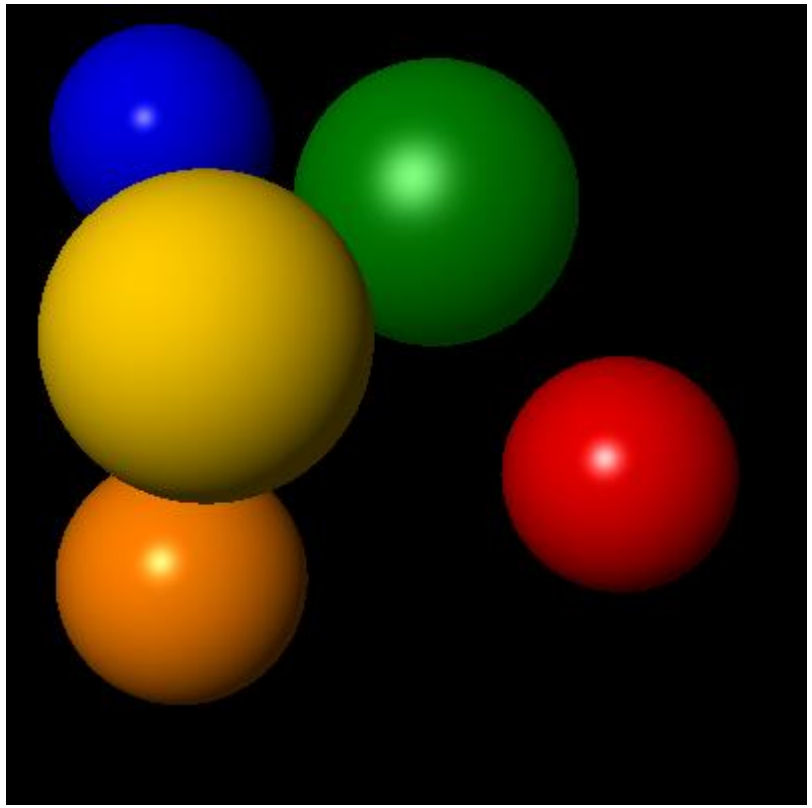
- overall intensity way too low

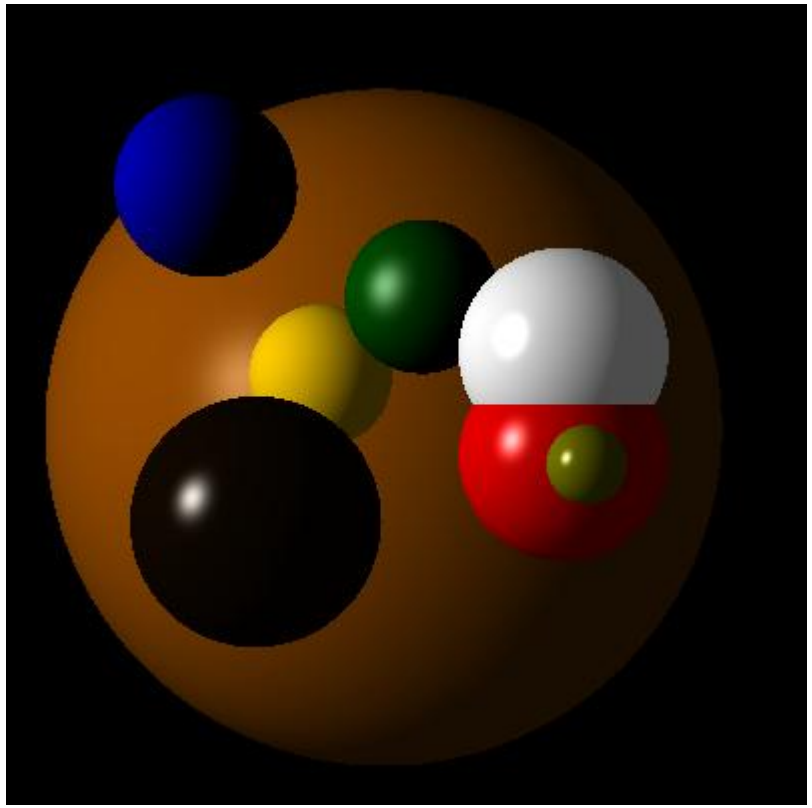




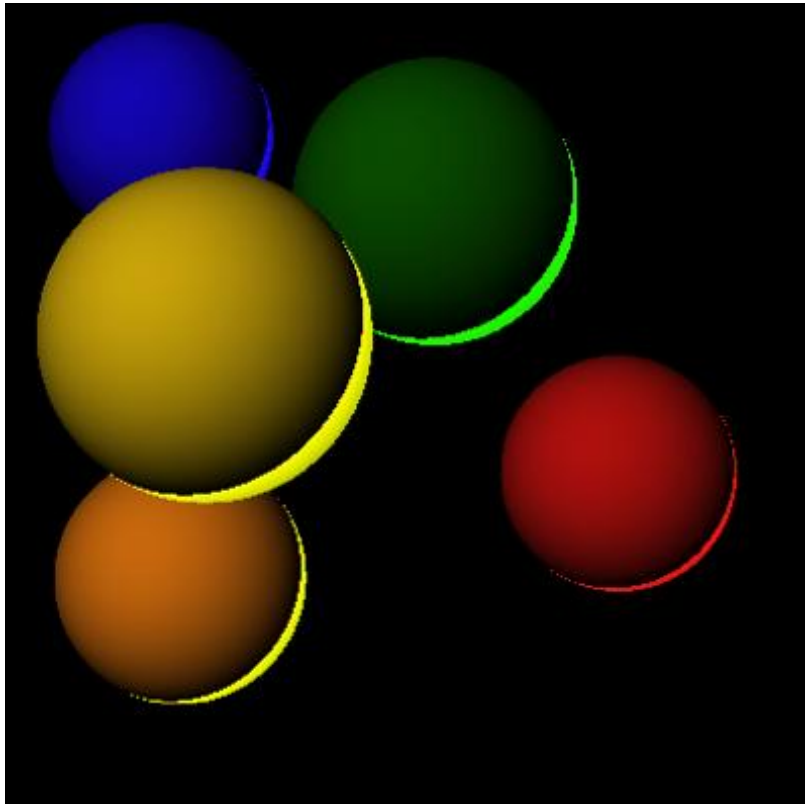
Possible problems

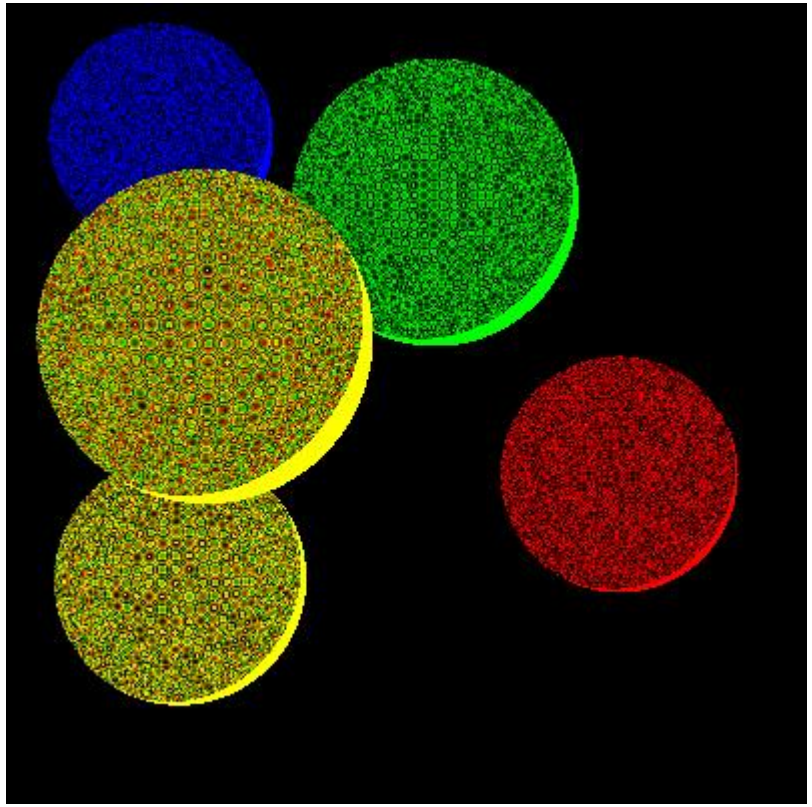
- specular reflection does not use object color, only light color



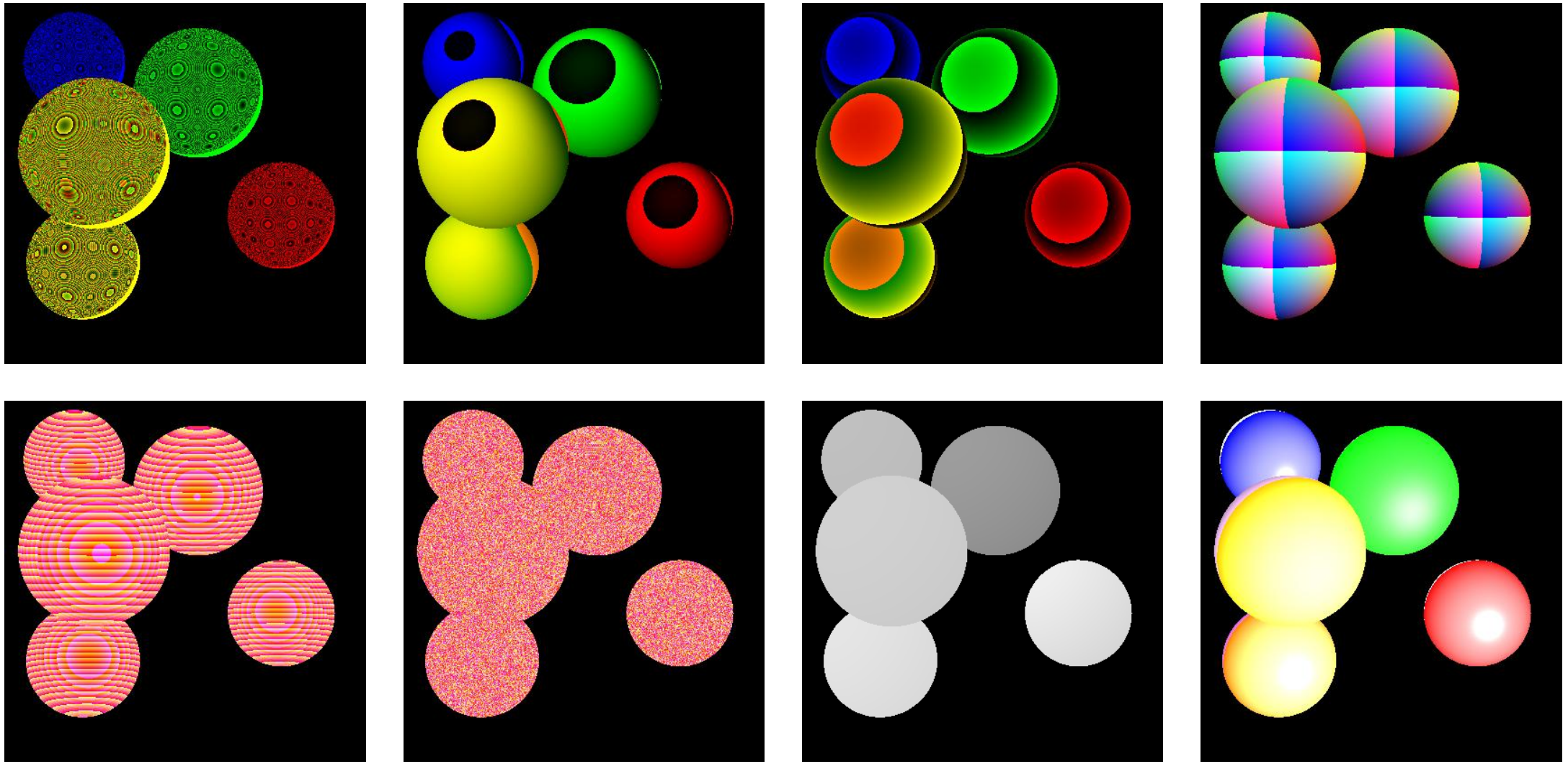


Missing errors





Other interesting mistakes (prev. years)



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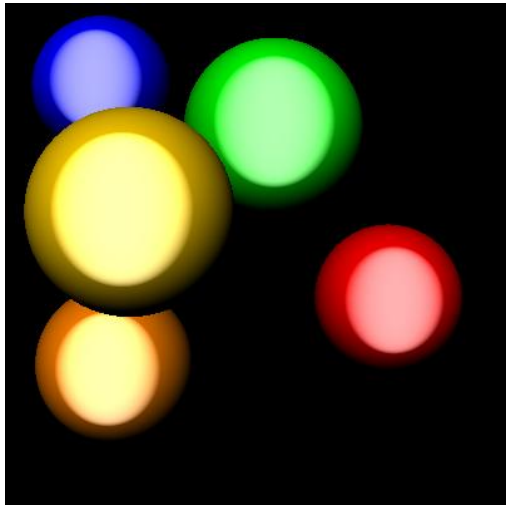
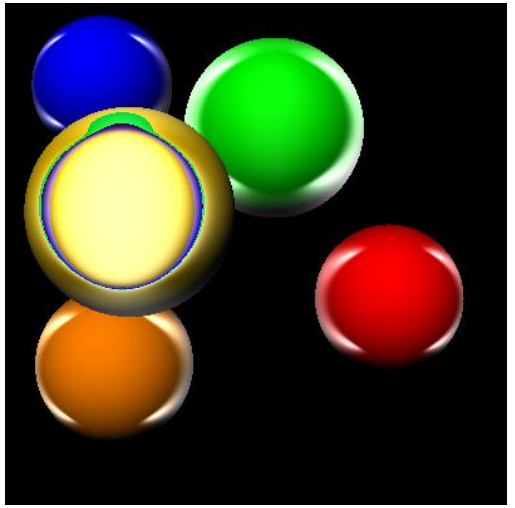
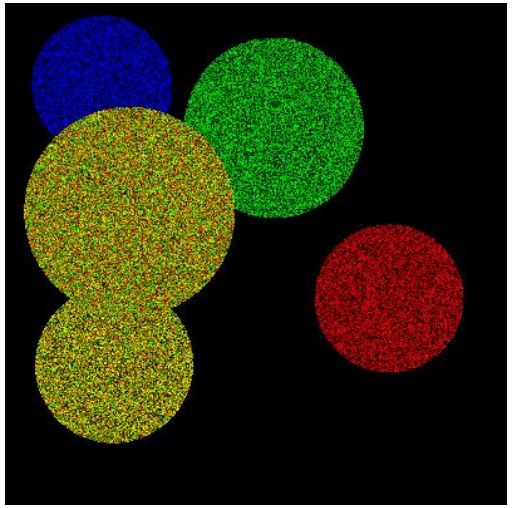
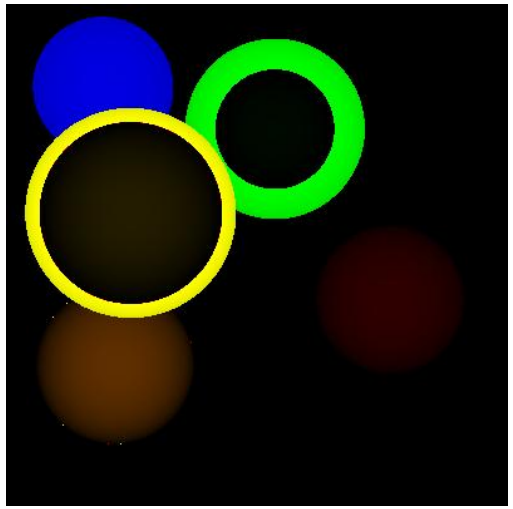
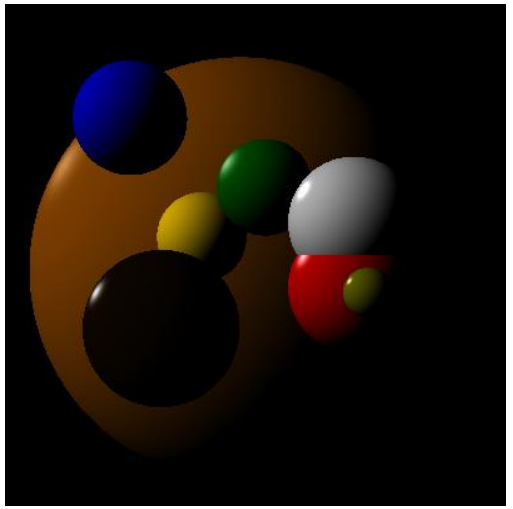
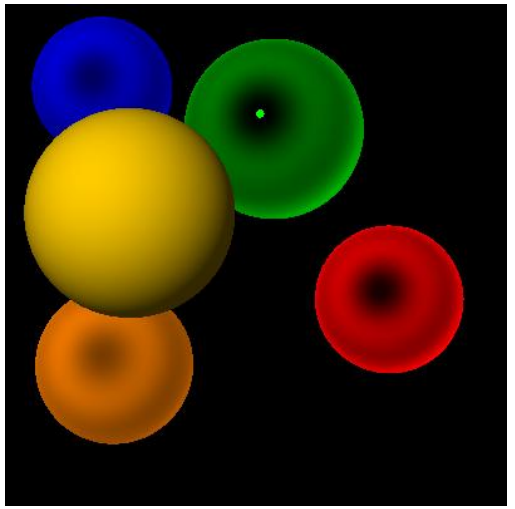
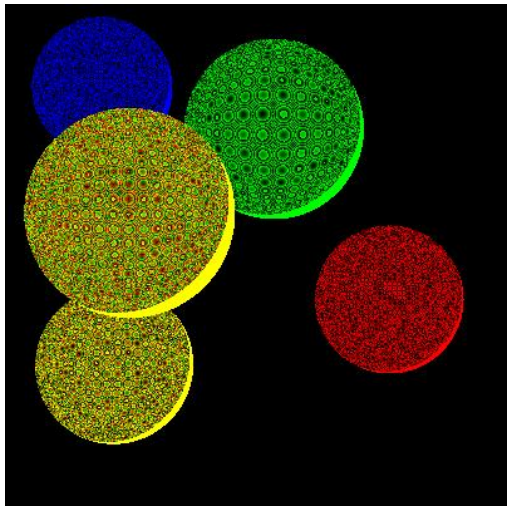
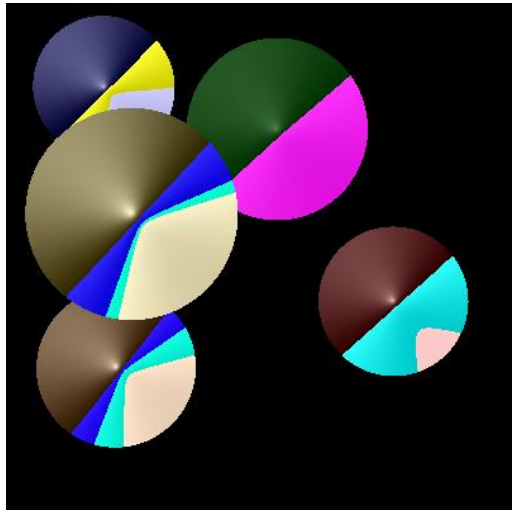
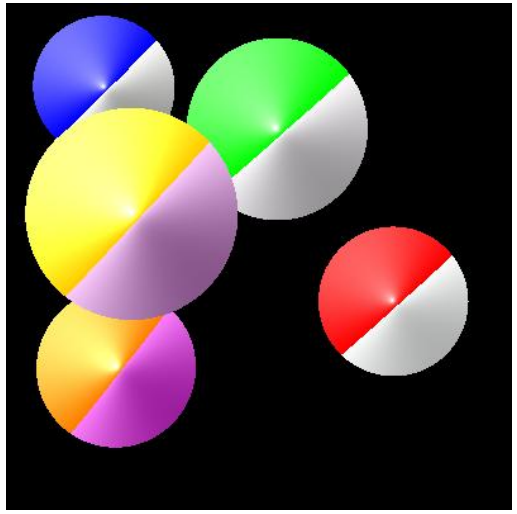
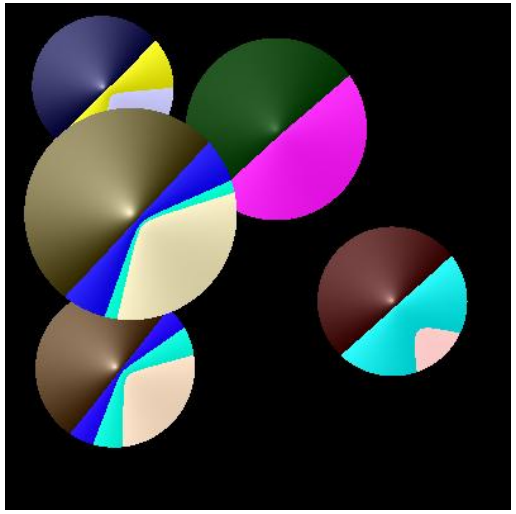
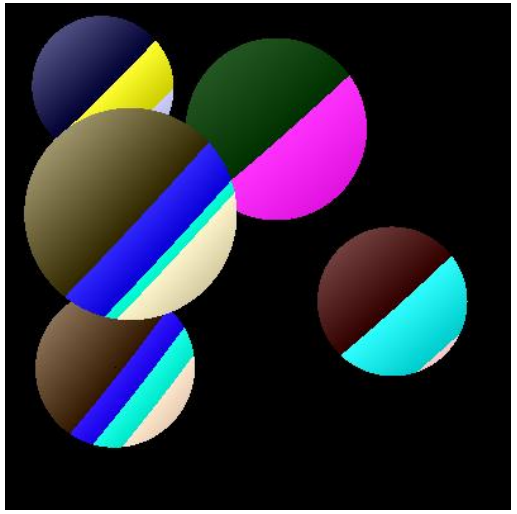
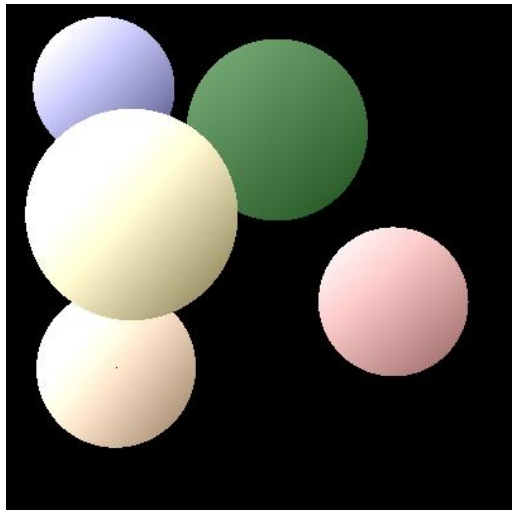
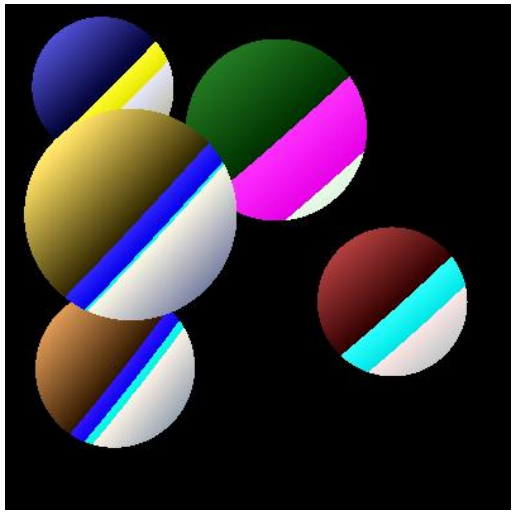
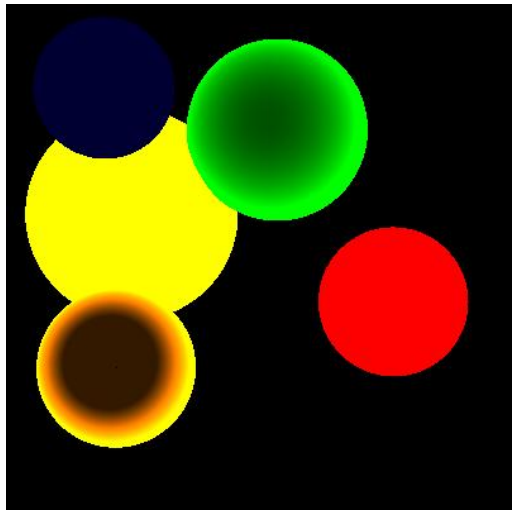








Other interesting mistakes (prev. years)

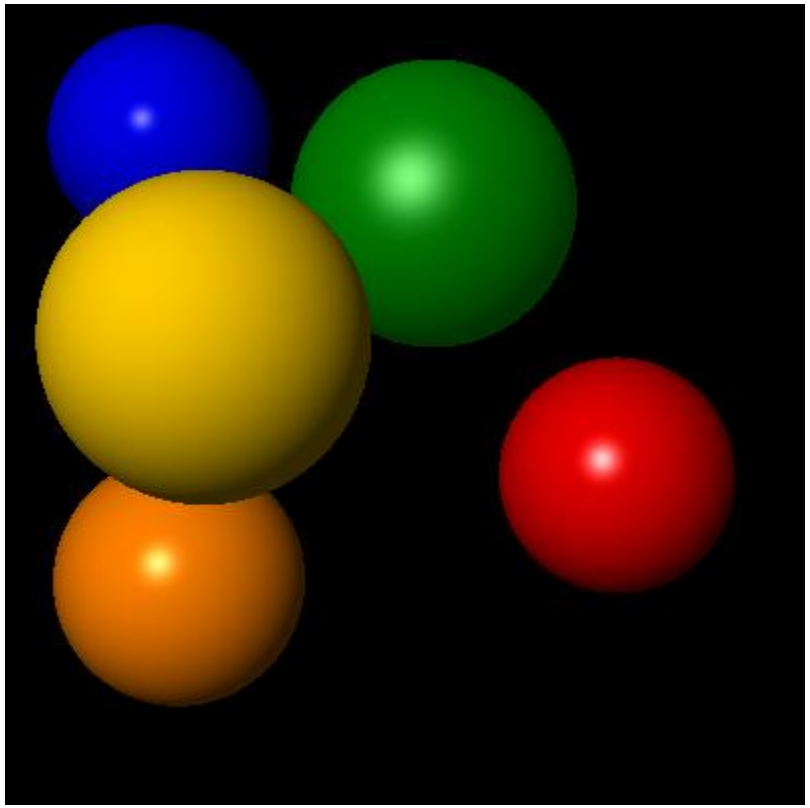








Some notes coding

- compare with examples on webpage
- use material properties from the scene file
- think about efficiency in the raytracer
  - stop calculations as early as possible
  - do not compute elements more than once (store them)
  - think about math, sometimes several alternatives
- rendering speed in general
  - use RELEASE compilation
  - use parallel computing: very easy using OpenMP

Compiler differences

- 0.5-pixel offset to the bottom-left (likely rounding behavior)

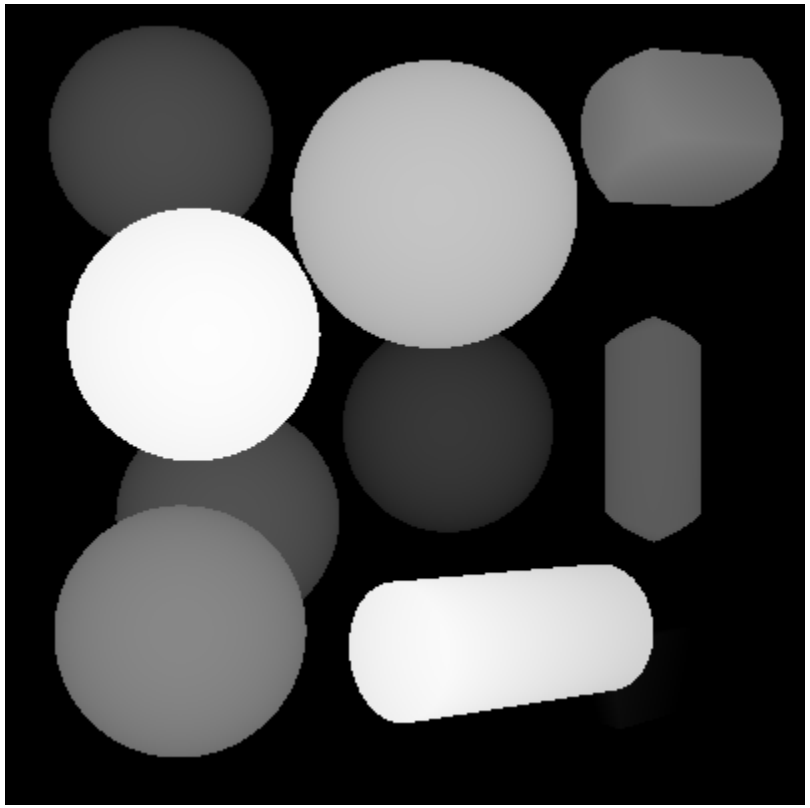


Efficiency in the raytracer

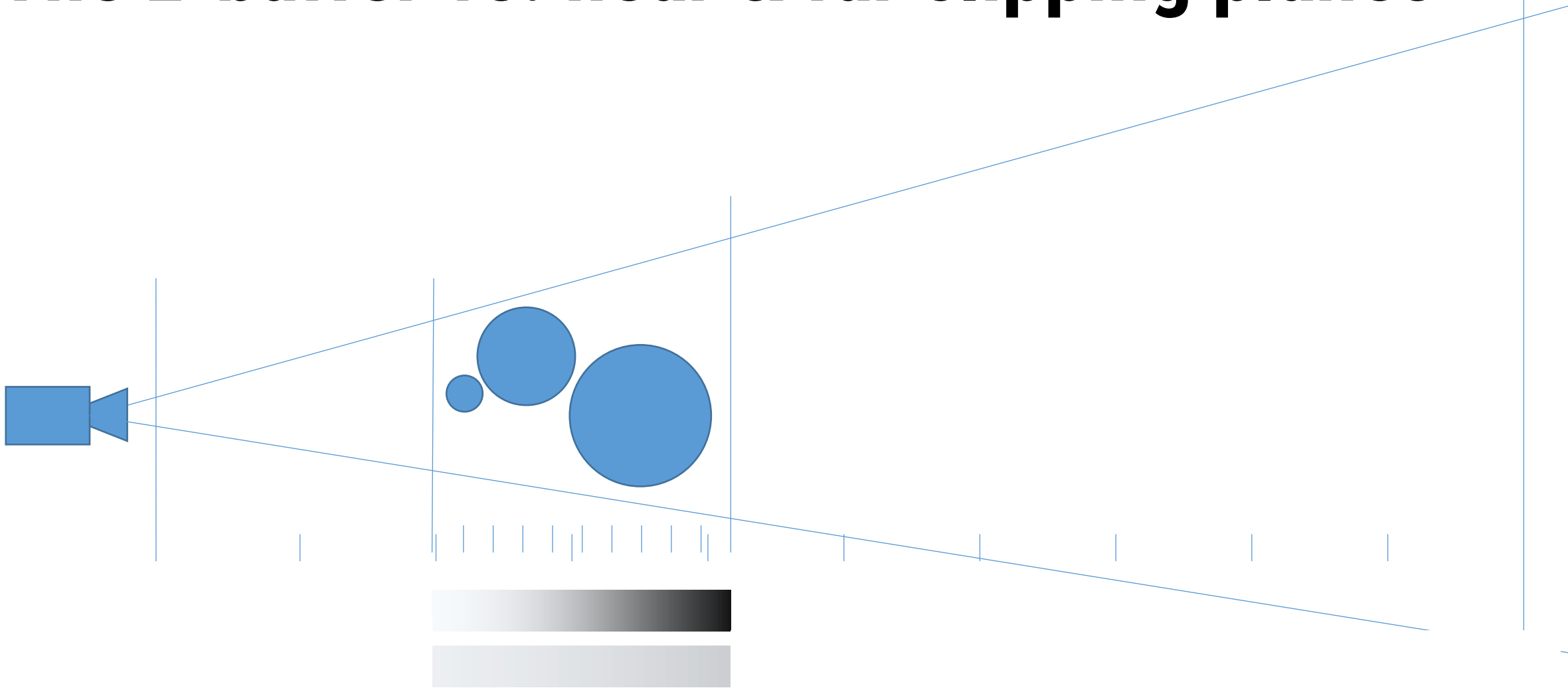
```
if (OC.dot(OC) - OC.dot(ray.D)*OC.dot(ray.D) > pow(r,2)){
        return Hit::NO_HIT();
    }
double t = OC.dot(ray.D) - sqrt(pow(r, 2) - (OC.dot(OC) - OC.dot(ray.D)*OC.dot(ray.D)));
```

Raytracer: assignment 2

- create z-buffer image
- gray-scale to encode depth
- need to define near & far **distance**
- make configurable in YAML file

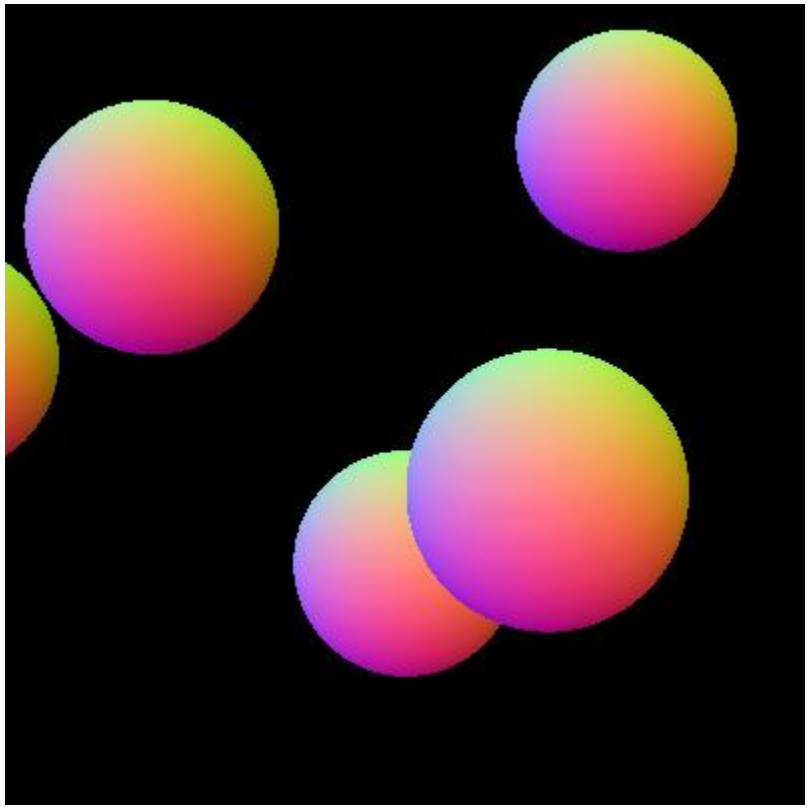


The z-buffer vs. near & far clipping planes



Raytracer: assignment 2

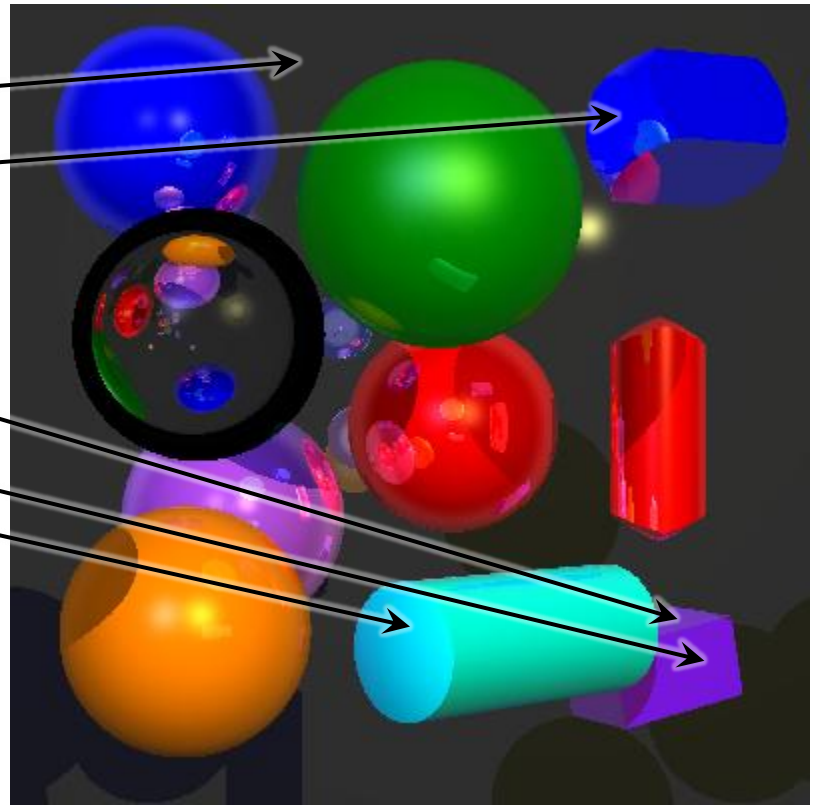
- normal buffer: visual representation of normals on the object's surfaces
- map [-1, 1] to the range of possible colors
- make configurable in YAML file



(different eye position and view direction)

Raytracer: assignment 2

- implement one more type of geometry:
  - quad
  - plane
  - box
  - cylinder
  - cone
  - triangle
  - torus
- to be added for each new geometry:
  - reading the parameters
  - intersection calculation
  - normal calculation



- make configurable in YAML file

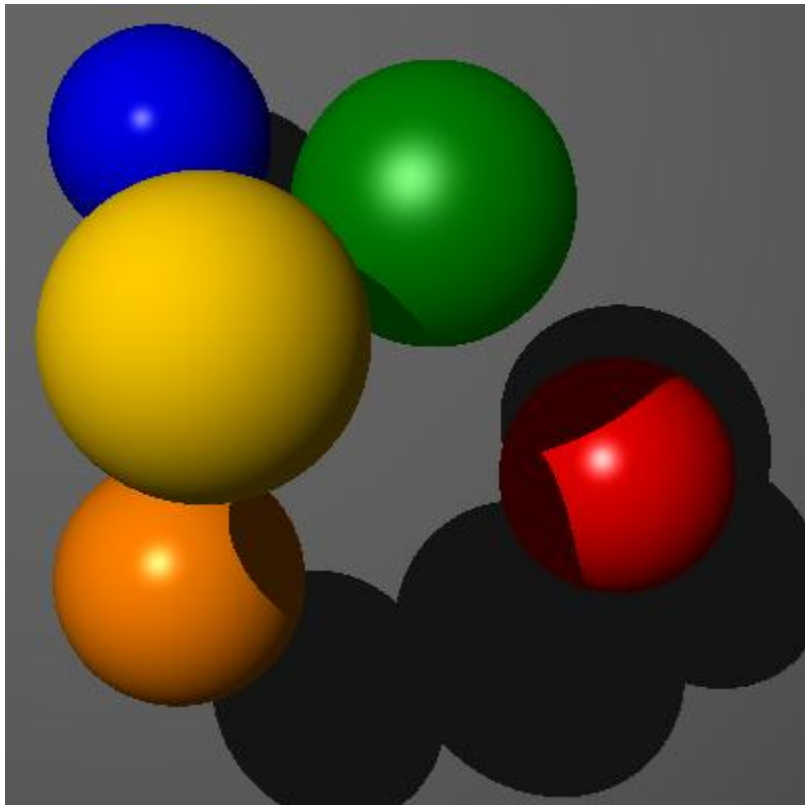
Adding to your raytracer: extend YAML file

```
Objects:
- type: sphere
  position: [90,320,100]
  radius: 50
  material: # blue
    color: [0.0,0.0,1.0]
    ka: 0.2
    kd: 0.7
    ks: 0.5
    n: 64
```

```
Output: 1 # 0 = regular, 1 = normal, 2 = zbuffer
Objects:
- type: cylinder
  position: [90,320,100]
  orientation: [1, 0, 0]
  radius: 50
  height: 70
  material: # blue
    # ... existing color and parameters
    albedo: [0.0,0.0,1.0]
    roughness: 0.2
    metalness : 0.2
```

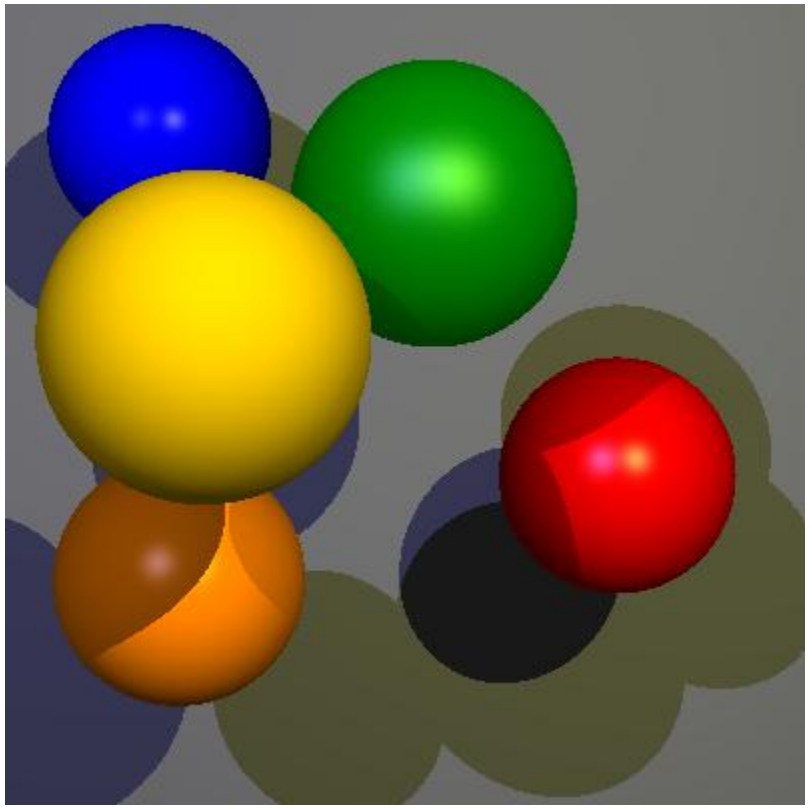
Raytracer: assignment 3

- produce shadows
  - trace rays from intersection point to light source and check for intersections



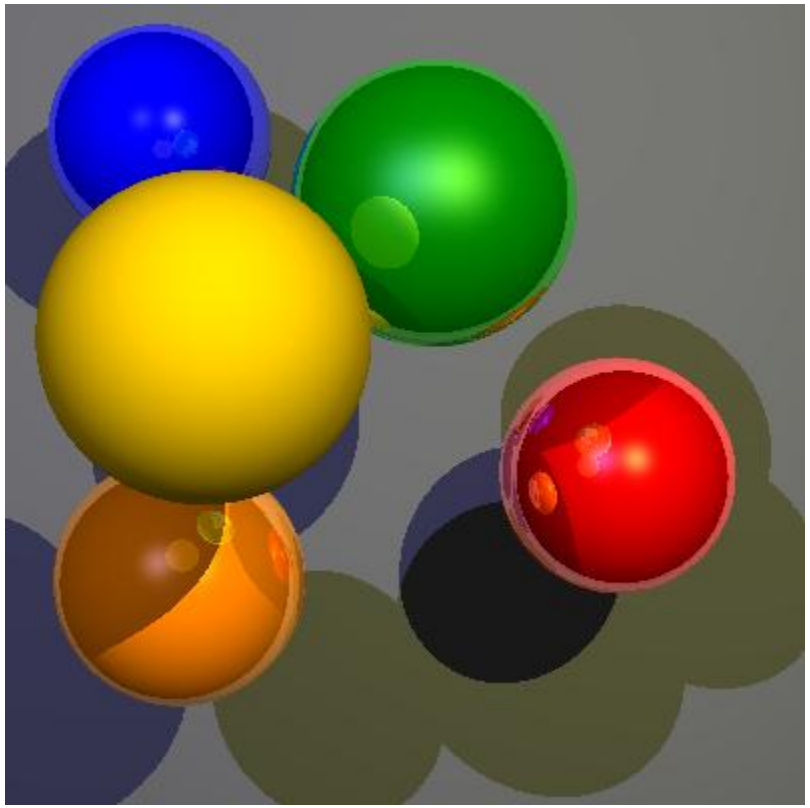
Raytracer: assignment 3

- correctly account for several light sources
  - illumination
  - shadows



Raytracer: assignment 3

- implement reflections
  - **recursion**
  - from raycasting to raytracing:
    - new ray from intersection point in direction of reflected ray
    - limit recursion to maximum number (ray gets another parameter)
    - include the contribution according to specular coefficient



Raytracer: assignment 3

- bonus: implement refractions
- bonus: make reflections of geometry also blurred, like the highlights of the light
- bonus: implement your own (cool) scene