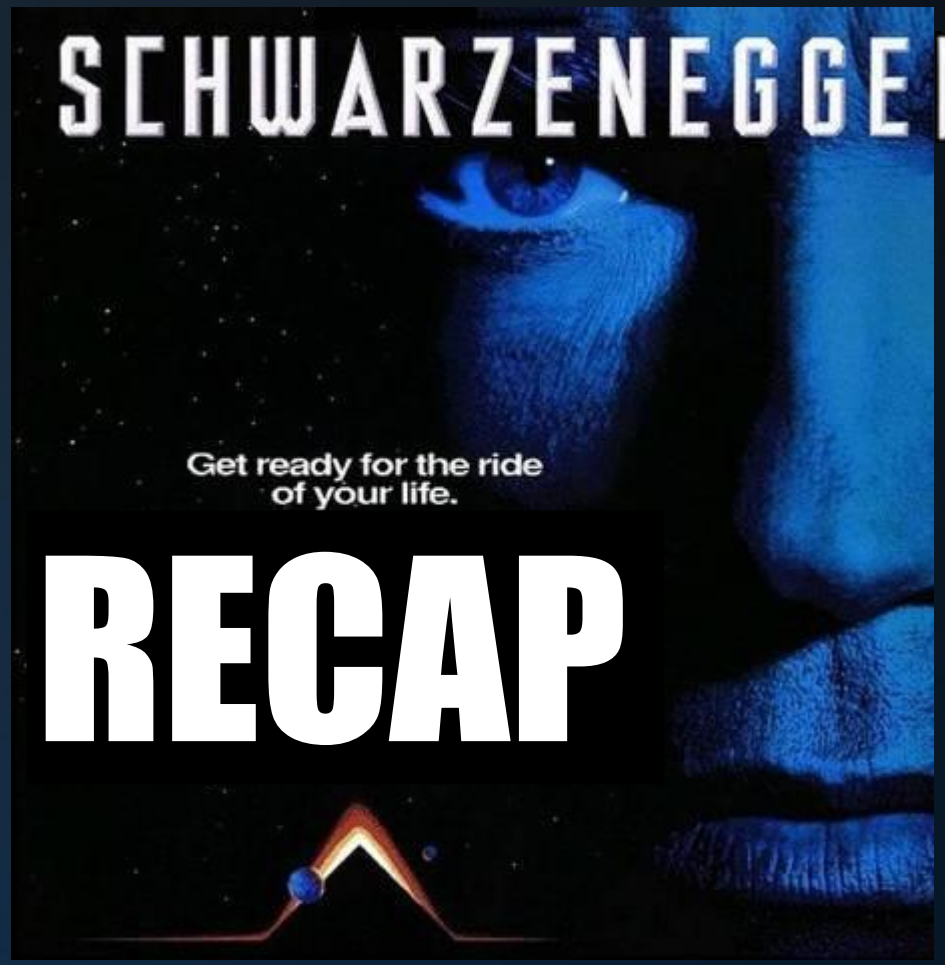


TOTAL RECAP

INFOGR – Computer Graphics

Jacco Bikker - April-July 2015 - Lecture 13: “Grand Recap”

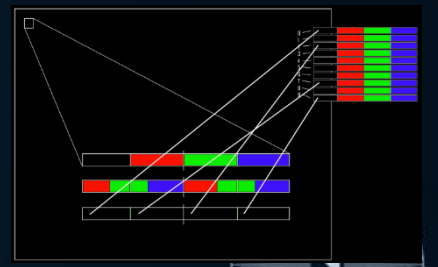
Welcome!

RECAP

Lecture 2: Rasters, Vectors, Colors

Math:
Vectors: magnitude, Pythagoras, linear (in)dependency, normalization, positions versus vectors, scalars, bases, Cartesian coordinate system, orthonormal, dot product (and its relation to the cosine), cross product.

Concepts:
Raster, frame rate, vertical retrace, ‘frame-less’, RGB colors, 16-bit, palletized, HDR.



Questions?

RECAP

Tutorial 1

Make sure you are able to:

- Show that the scalar product of vectors is commutative and associative;
- Show the relation between magnitude and the dot of a vector with itself;
- Show that for two random vectors $\vec{a}$ and $\vec{b}$, $\vec{a} \times \vec{b} = -(\vec{b} \times \vec{a})$ (exercise 6).
- Turn 2D coordinates into screen coordinates and vice versa (exercise 8).

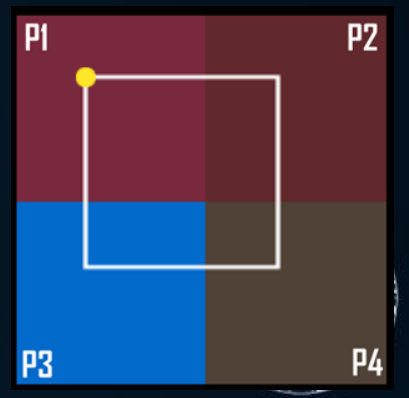
Not sure? Ask about this in the tutorial session after this lecture!

RECAP

Lecture 3: Geometry & Textures

Math:
Slope-intersect, implicit curves, functions, mappings, general implicit line form (and its relation to the normal), half spaces, parametric curves, SOHCAHTOA, implicit circles, implicit planes, parametric circles / spheres / planes.

Concepts:
Procedural textures, texture mapping, clamping and tiling, oversampling, undersampling, bilinear interpolation, MIP-mapping, trilinear interpolation.



Questions?

RECAP

Tutorial 2

Make sure you are able to:

- Turn a slope-intersect representation into parametric / implicit and vice versa;
- Calculate the normal for a pair of (linear independent) vectors;
- Calculate the distance of a point to a sphere.

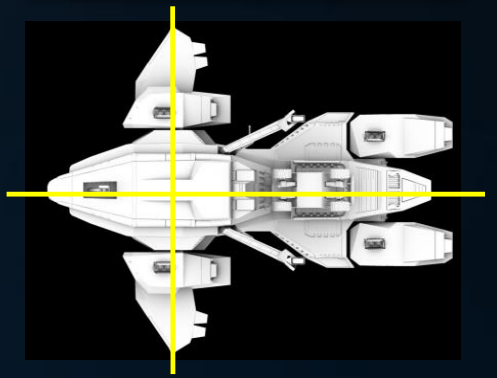
Not sure? Ask about this in the tutorial session after this lecture!

RECAP

Lecture 5: Engine Fundamentals

Math:
Matrices: coefficients, diagonal matrices, the identity and zero matrix; matrix addition, matrix/scalar, matrix/vector and matrix/matrix multiplication, distributive, associative, commutative, transpose, inverse, determinant, Laplace, Sarrus, cofactors, adjoint, (uniform) scaling, shearing, projection, reflection, rotation, linear transforms, transforming normals.

Concepts:
Rendering pipeline, scenegraph, object space, camera space, screen space, connectivity data, fragments.



Questions?

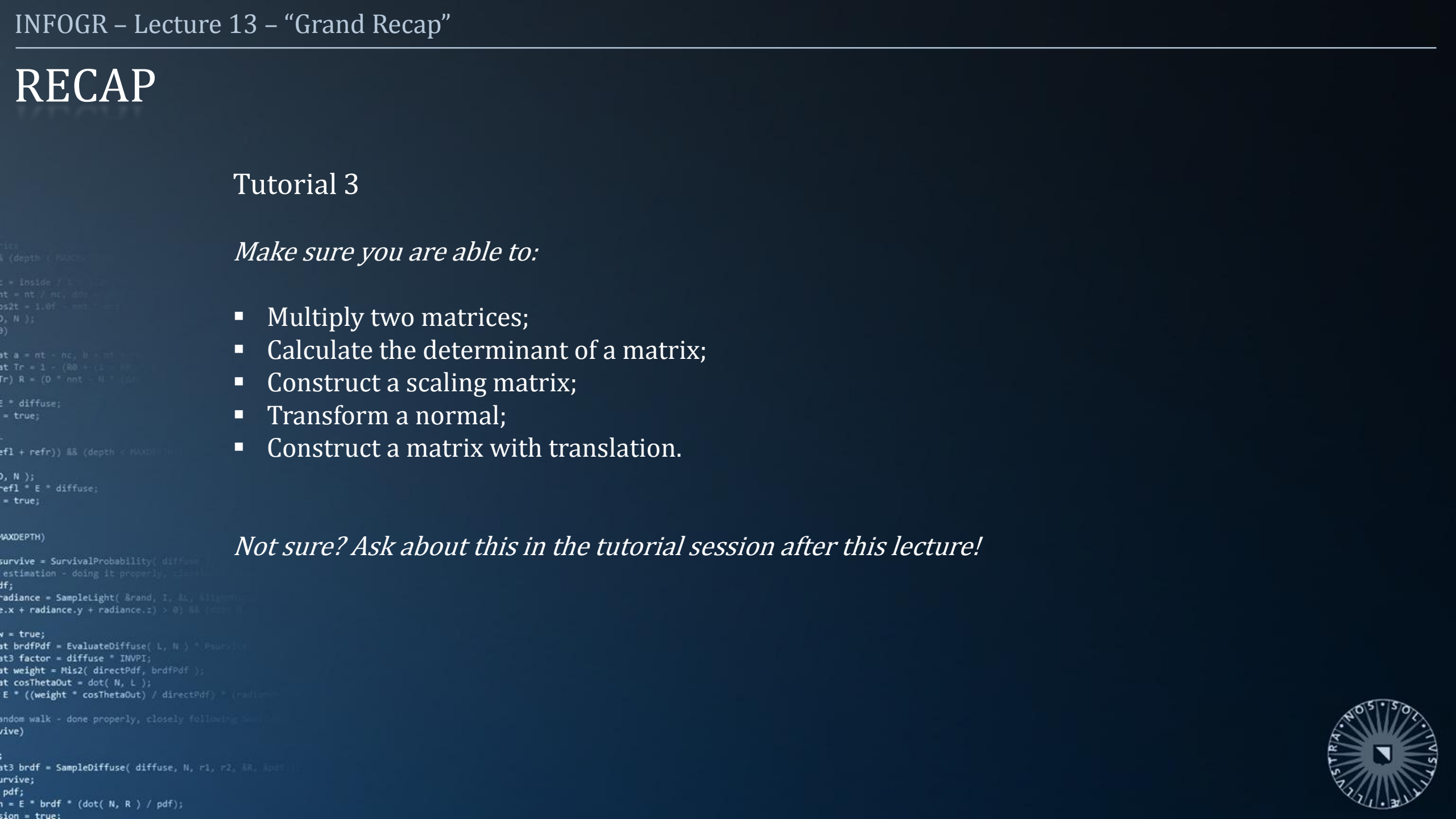
RECAP

Tutorial 3

Make sure you are able to:

- Multiply two matrices;
- Calculate the determinant of a matrix;
- Construct a scaling matrix;
- Transform a normal;
- Construct a matrix with translation.

Not sure? Ask about this in the tutorial session after this lecture!

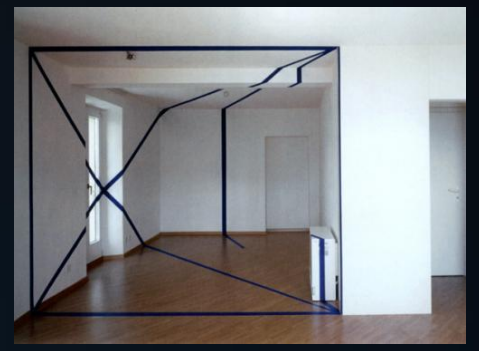


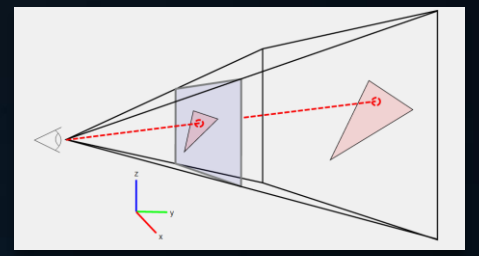
RECAP

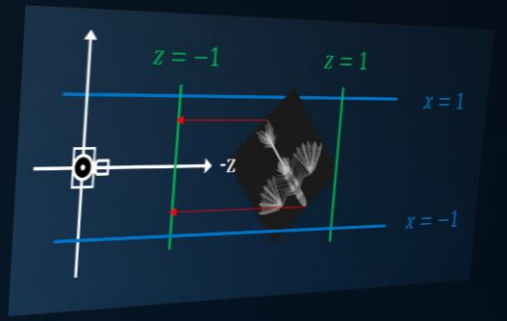
Lecture 6: Projection & Rasterization

Math:
View frustum, camera space, orthographic view volume, canonical view volume, perspective projection, homogeneous coordinates, homogenization.

Concepts:
Linear perspective, fish eye lens, parallel projection, perspective projection, rasterization, connectivity data, triangle strips, normal interpolation, per-vertex shading, per-pixel shading, light reflection, barycentric coordinates.







Questions?

RECAP

Tutorial 4

Make sure you are able to:

- Construct a ‘look-at’ matrix using E, $\vec{V}$ and $\overrightarrow{up}$;
- Combine multiple affine transforms into one;
- Transform a 3D vector using a 4×4 matrix (including homogenization).

Not sure? Ask about this in the tutorial session after this lecture!

RECAP

Lecture 7: Visibility

Concepts:
Painter’s, overdraw, BSP traversal (back-to-front, front-to-back), z-buffer, values in the z-buffer, z-fighting, Sutherland-Hodgeman clipping, n-gons, guard bands, back-face culling, frustum culling, hierarchical bounding volume culling, culling using a grid, portals: visibility, mirrors, ‘portals’.

Questions?

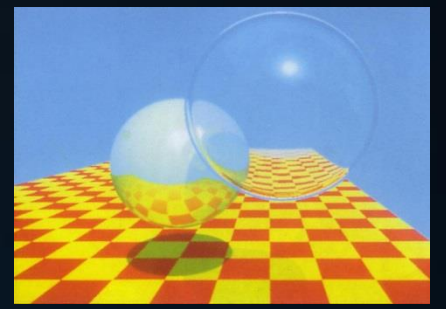
RECAP

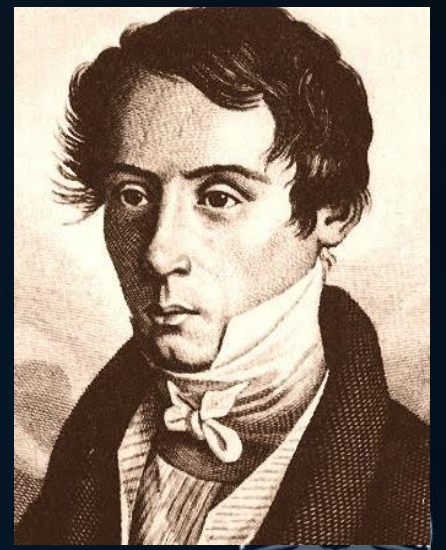
Lecture 8: Ray Tracing Intro

Math:
Rendering equation, ray equation, setting up a world space screen plane, ray setup, ray/plane and ray/sphere intersection, distance attenuation, N dot L.

Concepts:
The “God Algorithm”: light transport in nature, ray tracing versus rasterization, convex / concave, reflection and shadows in a rasterizer, global data, ray optics, Fresnel, Snell, Whitted-style (recursive) ray tracing.

Questions?





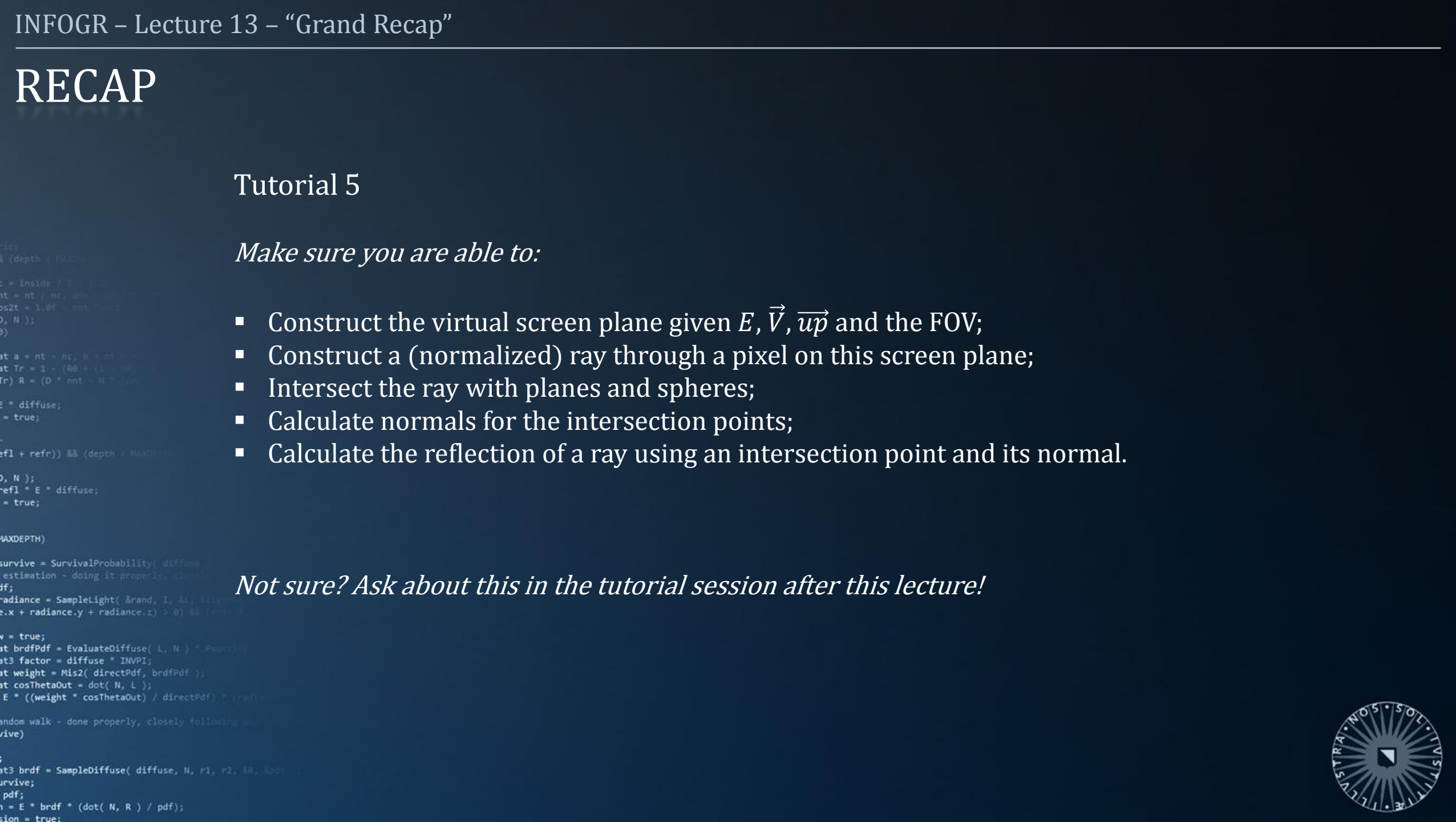
RECAP

Tutorial 5

Make sure you are able to:

- Construct the virtual screen plane given E, $\vec{V}$, $\overrightarrow{up}$ and the FOV;
- Construct a (normalized) ray through a pixel on this screen plane;
- Intersect the ray with planes and spheres;
- Calculate normals for the intersection points;
- Calculate the reflection of a ray using an intersection point and its normal.

Not sure? Ask about this in the tutorial session after this lecture!

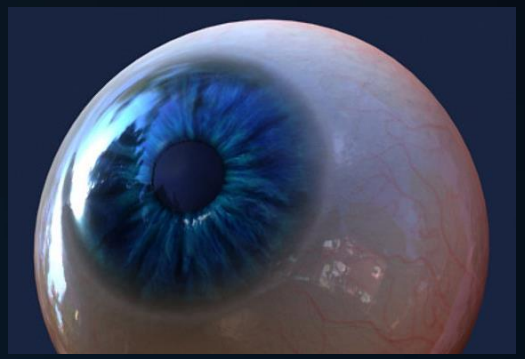


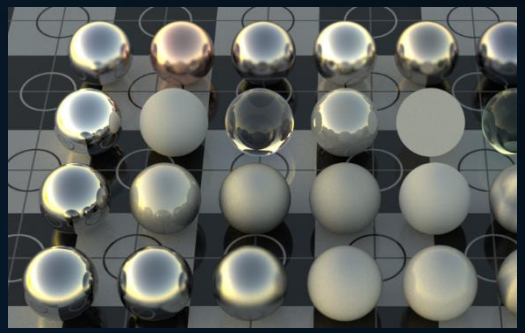
RECAP

Lecture 9: Shading Models

Math:
Clamped cosine, irradiance: integrating over hemisphere, steradians.

Concepts:
Light transport: emitters, surfaces and materials, sensors; IES lights, absorption, scattering, directional lights, irradiance, material properties, optical discontinuities, exitance, radiance, pinhole camera, aperture, shading, BRDF, Phong, ‘ambient’, physically based rendering.





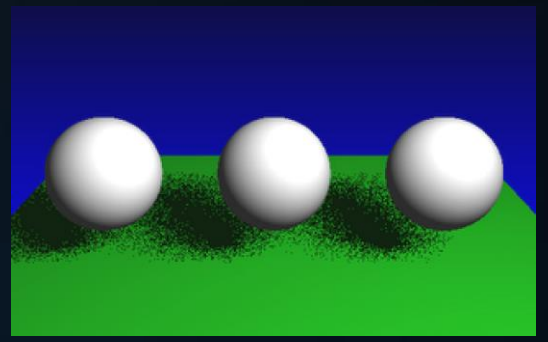
Questions?

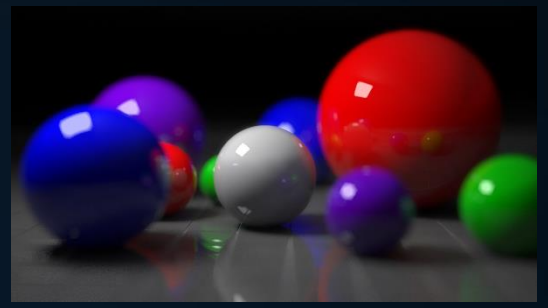
RECAP

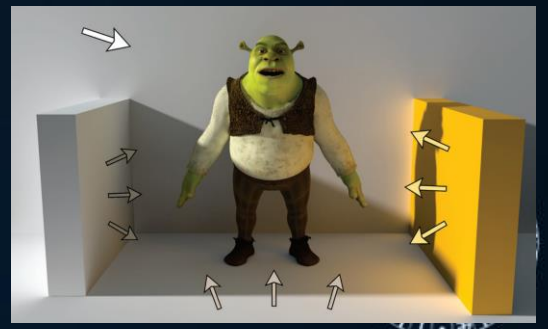
Lecture 10: Ground Truth

Concepts:
Distributed ray tracing, glossy reflections, soft shadows, umbra, penumbra, area lights, shadow maps, contact shadows, visibility integral, Monte-Carlo, stochastic soft shadows, variance / noise, stochastic reflections, stratification, depth of field, motion blur, dispersion, anti-aliasing, ray tree, indirect light, path tracing.

Questions?



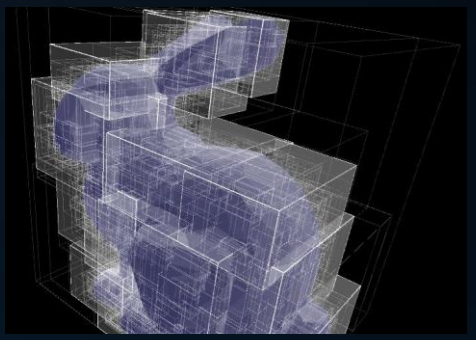




RECAP

Lecture 11: Accelerate

Concepts:
Required ray tracing performance, grids / nested grids / octrees / kD-trees (and their (dis)advantages), the bounding volume hierarchy, BVH construction, BVH traversal, BVH size bounds, BVH depth, good BVHs: SAH, construction termination, packet traversal.



Questions?

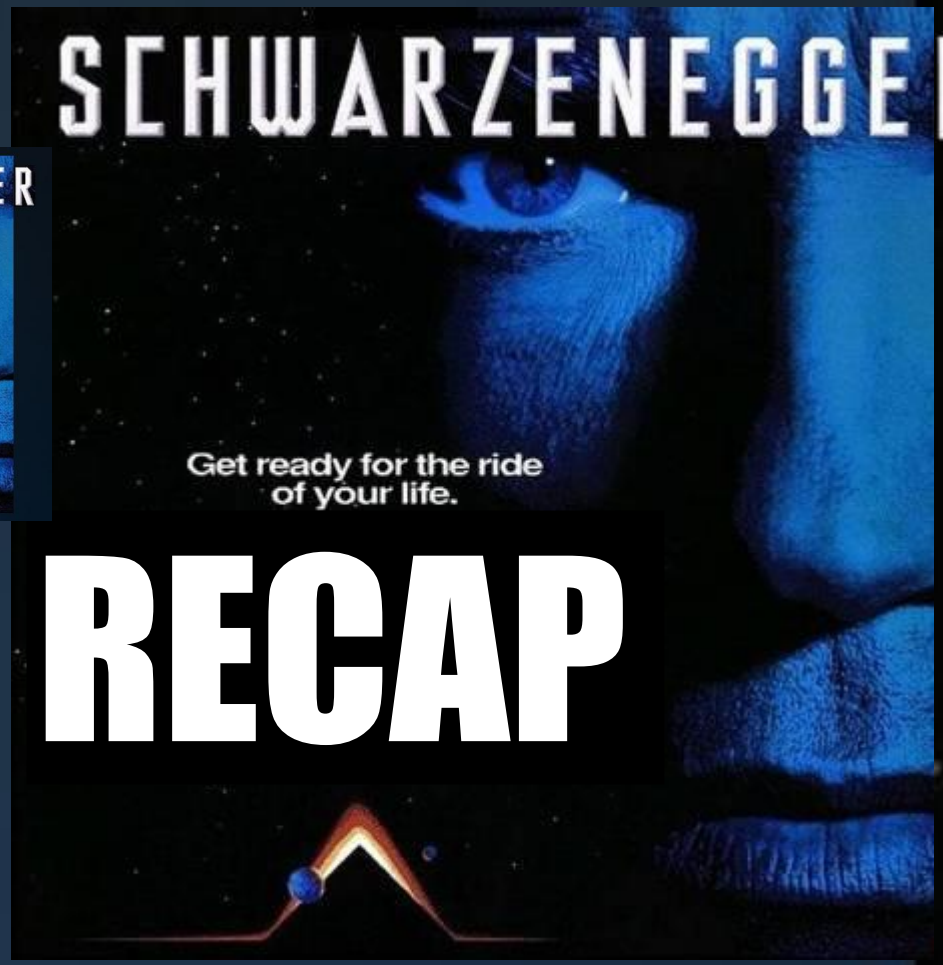
RECAP

Lecture 12: Post Processing

Concepts:
Post processing, camera / sensor behavior, lens flares, vignetting, chromatic aberration, noise / grain, HDR bloom and glare, tone mapping / exposure control, color correction / grading, gamma, gamma correction, depth of field, circle of confusion, ambient occlusion, screen space AO, bilateral filtering, screen space reflections, limitations of screen space approaches.

Questions?

RECAP



TOTAL RECAP

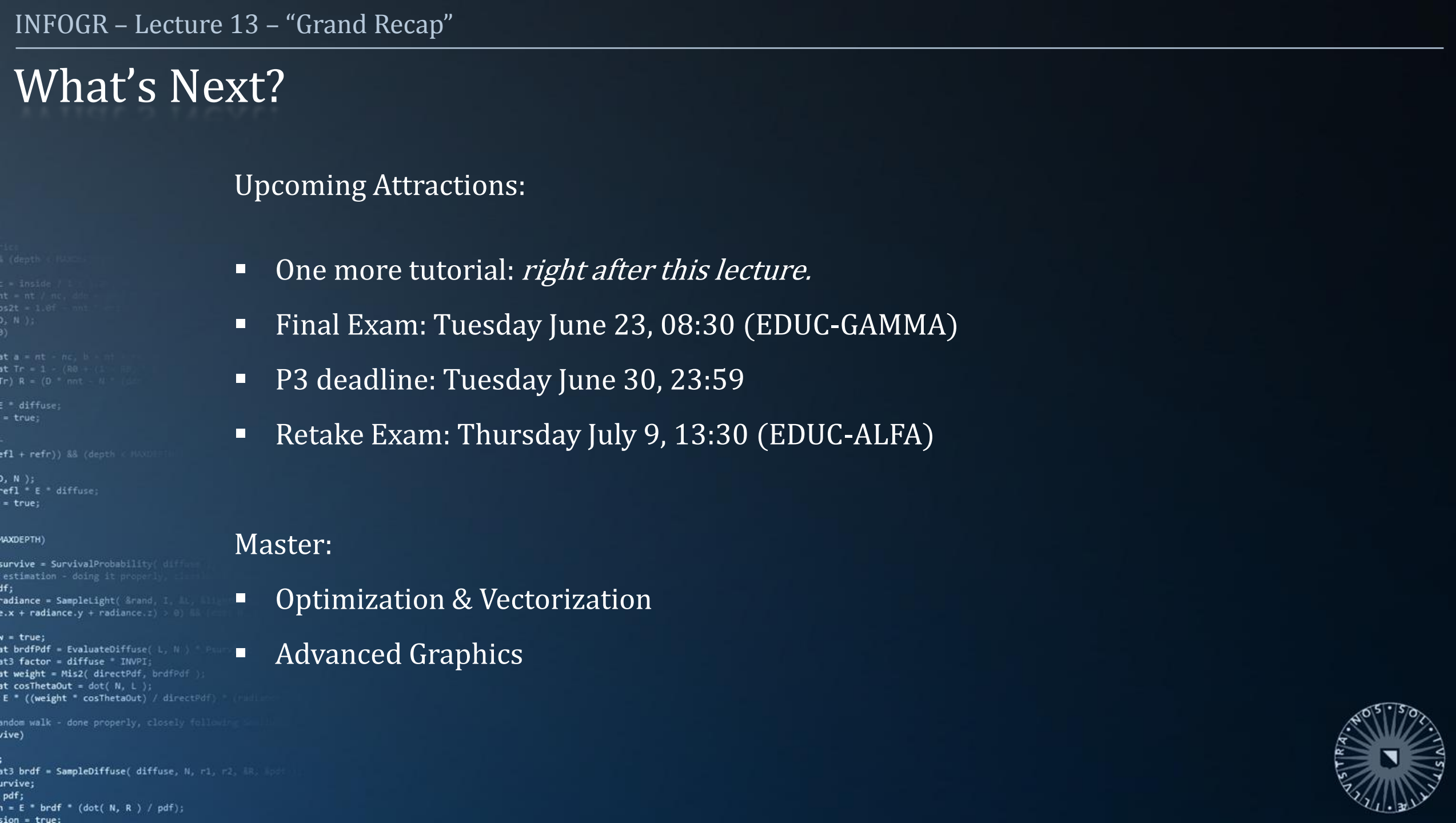
What’s Next?

Upcoming Attractions:

- One more tutorial: *right after this lecture.*
- Final Exam: Tuesday June 23, 08:30 (EDUC-GAMMA)
- P3 deadline: Tuesday June 30, 23:59
- Retake Exam: Thursday July 9, 13:30 (EDUC-ALFA)

Master:

- Optimization & Vectorization
- Advanced Graphics



INFOGR – Computer Graphics

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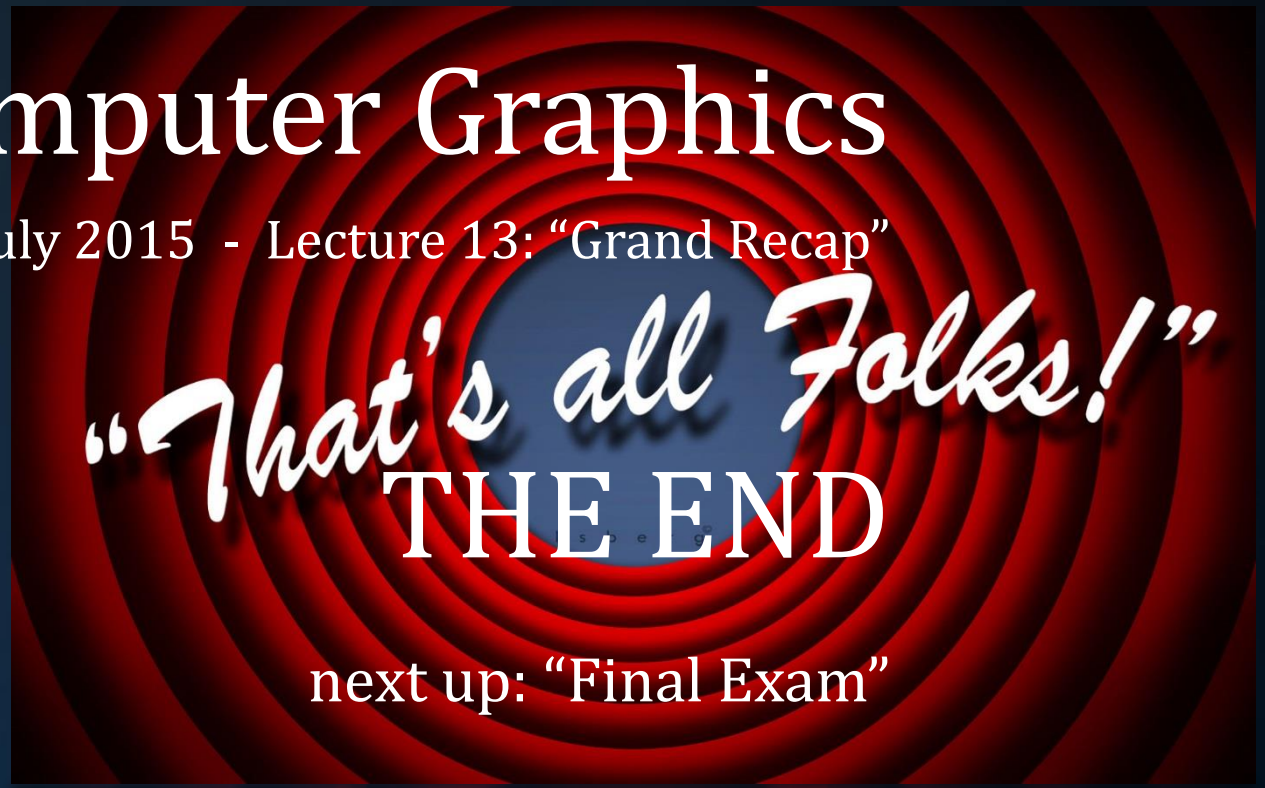

THE END

next up: “Final Exam”