VIRTUAL LIGHTING SESSION TWO SYLLABUS

SESSION TWO OBJECTIVES

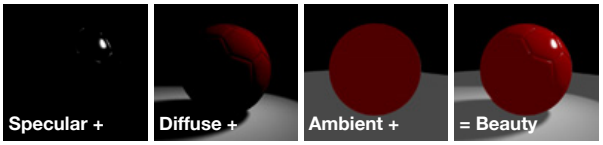
Session one was an introduction to what lighting becomes when used in computer graphics. An exploration of what CG can and cannot do was offered along with a brief, but deep, overview of the accompanying challenges and limitations.

1 - Lighting in production - Hour 1

In computer graphics, **Lighting** is the interaction between light sources and material descriptions. For example, colors on the faces of a model are altered according the angle and distance to light sources.
The concepts of “lighting”, “shading” and “rendering” will be defined as each being pivotal, but they are often mistaken one for the other.
I will review in detail the notion of “layering” which is central to CG. The materials (aka shaders) created for lighting and compositing, all heavily use passes to control the final look of the images.
I will introduce more examples from movies and commercials, on which I have worked, in order to highlight these concepts. Some steps involved in the process will also be re-created live during the lecture.

The challenges related to rendering time, bugs and human mistakes and limitation we encounter on a typical production, will be described and explored in detail.

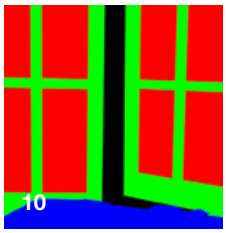
Next is an explanation of the different steps involved in the production of photorealistic images.

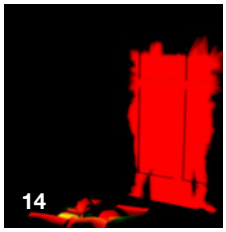


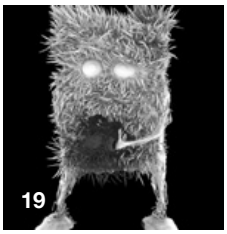
2 - Direct lighting - Hours 2-3

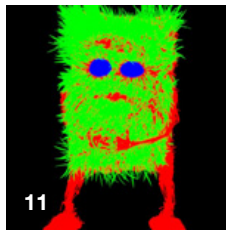
I will explain the different types of light source we have: spotlights, area lights, point lights, directional lights, and show their specificities and limitations.

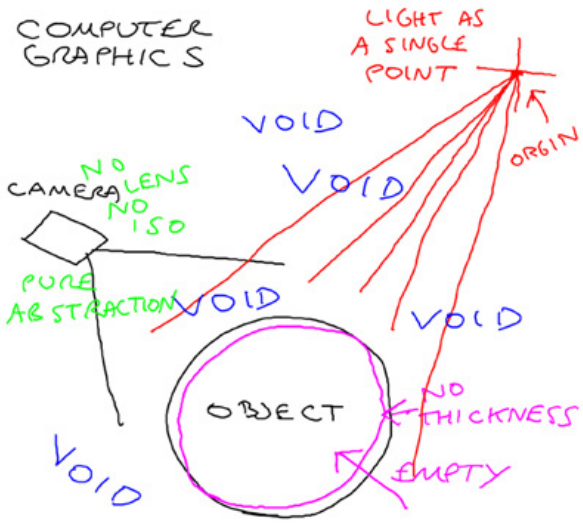
The cinematographer might be puzzled by CG light behavior. They are abstract constructs, and as such, they do not emit heat, they have no weight, and are not, by themselves, visible. They can be placed in front of a camera and not obstruct the view. They are invisible because they are “rays” emission, usually from a single point in space, therefore you only know they exist because you see their effects on materials.
They do not use Watts or Kelvin measures and use abstract values and concepts, like dissociating intensity and color. The user has to define the shape and fringe of the shadows. Their *falloff* that decreases the intensity of a light source over distance is totally customizable.
Light can be used to illuminate only some objects while others are ignored. Or even more unusual: a light can exclude from its illumination a distinctly chosen material, and not illuminate the other materials present in view.

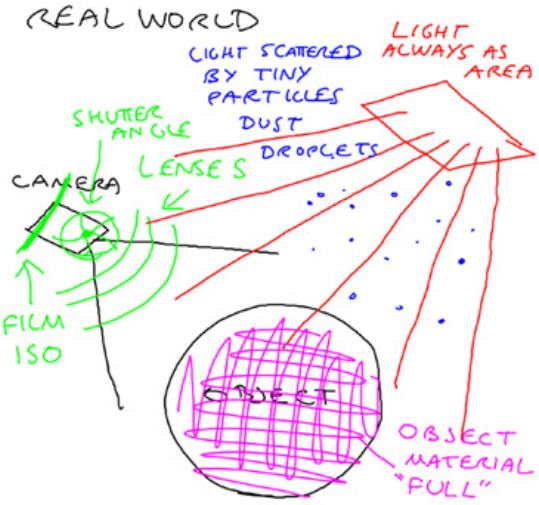


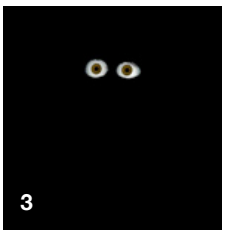


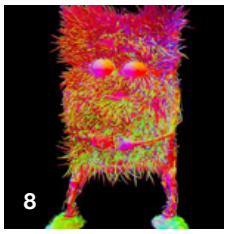












«He who believe that in business the machine is more important than the person who operates it will soon lose both.»

Confucius

Because the cinematographer cannot use familiar tools such as f-stops, shutter angles, and film speed, it might be frustrating and challenging at first to adjust from a real world equivalent to digital techniques.

I will review all of this during the seminar and show how CG artists must rely on time-honored techniques such as the classic key-fill-rim combination to light virtually, but it IS real world lighting, without question.

3 - Indirect lighting - Hours 4-5

Light versus shade is a basic lighting concept in visual arts that applies to CG. Shade is pitch-black when no CG light illuminates it, this is direct illumination provided by the sun for example.
What about the sky influence? How to simulate an overcast day when no direct light is visible? The sky illumination will light the shade and the lit areas, this is called **indirect lighting**, this is a genuine challenge for all CG lighting artists.

Usually **indirect lighting** means low-profile light fixtures diffusing a soft light on the surrounding areas. This helps prevent excessive brightness and contrast. This is usually not what we mean in CG. **T**he term relates mainly to some specific techniques such as **final gathering** or **global illumination,** that simulates an ambient type of illumination that cannot be created by CG lights alone.
In CG, colored areas do not reflect diffusely on each other per default, we call this **color bleeding**, an extra amount of care, is necessary (along with longer rendering times).

Reflectors are commonly used on set to re-orient some illumination in a desired direction, modern techniques such as final gathering in CG allow the Cg artist to do the same, this is not very different of the real world.
We will realize than CG lights sources are not the only way of creating illumination.

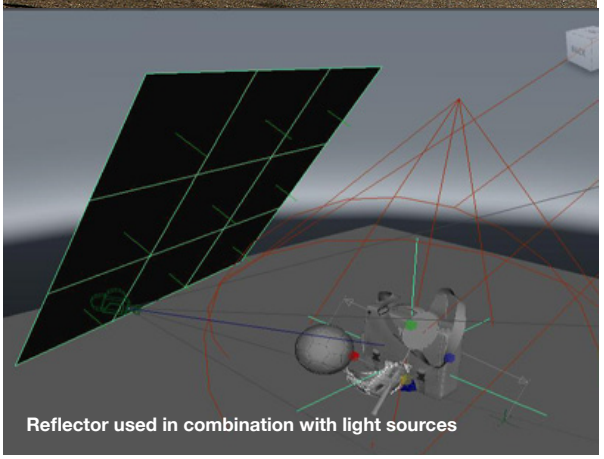
Indirect lighting applied to the CG world comes with 5 flavors:
Ambient occlusion: Pure geometry proximity calculation. No CG light needed.
Final gathering: Bouncing color bleed based on geometry proximity
Ambient shader and lights : Multiplier added on the material and Light source that only lift up material descriptions values.
Global illumination: Bouncing color bleed based on CG lights rays.
CG lights without reflections and dimmed intensity: Materials won't create specular highlights .

I will show these different techniques in combination and explain their pro and cons.

4 - Environment lighting - Hours 6-7

Any object reacts with its environment. From the early days of CG, people tried to simulate visually the placement of a CG model in our world.
The creation of some lighting set-up that will reproduce the interactions with the real world (such as reflections or light influences) is time conssuming.


Credits: From Wikepedia, Brocken Inaglory


Reflector used in combination with light sources

Environmental mapping, or **reflection mapping**, is a lighting technique for approximating the appearance of a reflective surface with an image which becomes the distant environment surrounding the rendered object.
We will study in detail the full process:
1 - The gathering of information during the shot.
Grids, grey and chromium probes.
We will compare the probe and fish eye methods.
2 - Information processing.
Tone-mapping, unwrapping the probes. Working with Photoshop, Nuke and PTGui.
3 - The use of real-world information in a CG scene.
Environmental mapping concepts: cubic, spherical and geometry.

5 - Rendering and compositing - Hour 8

MentalRay, Vray or Renderman are labelled as renderers, rendering is therefore the process of generating a 2D image from 3D geometry according to the instructions given by the user through his use of **lighting** and **shading**.
Their interactions are computed in the **rendering** phase when we compute the visual result as an image. Shaders being made from layers of visual information that can be broken down and split in passes, this is a rendering sub-task. These passes will be re-assembled in **compositing.** The close relationships both areas have will be made clear and highlighted.

6 - Shading and lighting - Hour 9

In computer graphics, **Shading** is the ensemble of techniques used to define material descriptions called **shaders**. Shaders are lists of layered instruction defining the color of a pixel. Shading defines any type of materials, with our current emphasis on realism. We usually assume that the goal of shading is to reveal the shape of a model and to mimic real-world materials. Because a light that has nothing to light is useless. I will show how materials, aka shaders, work in CG. As examples, I will tweak some typical material appearances: wood, brushed metal, plastic and ivory.

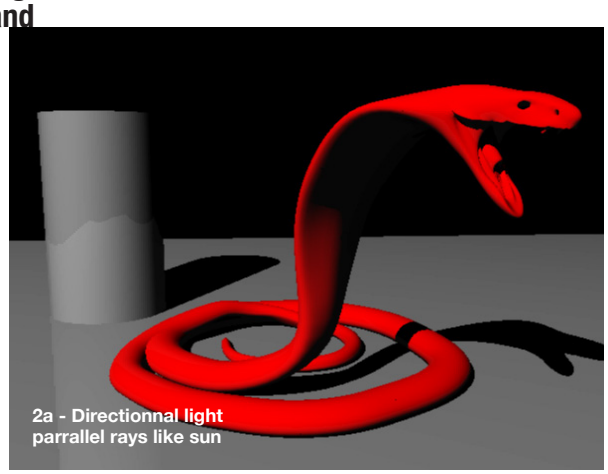
In our world, facing any source light creates flares and glows. As pure rays coming from a single position (like spotlights) in CG there is literally “nothing” at all at the origin. I will demonstrate how we “light” the “light” sources.

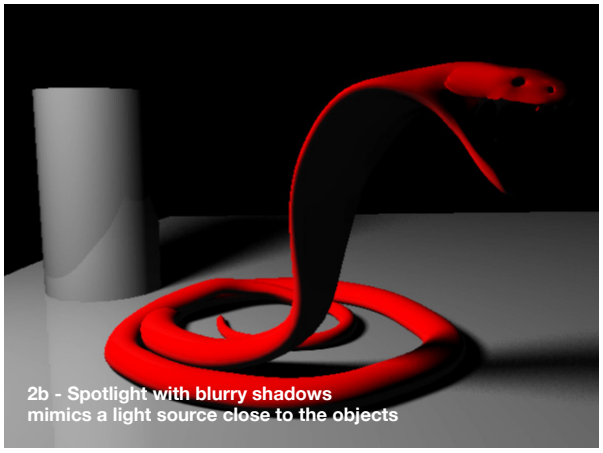
SESSION TWO CONCLUSION

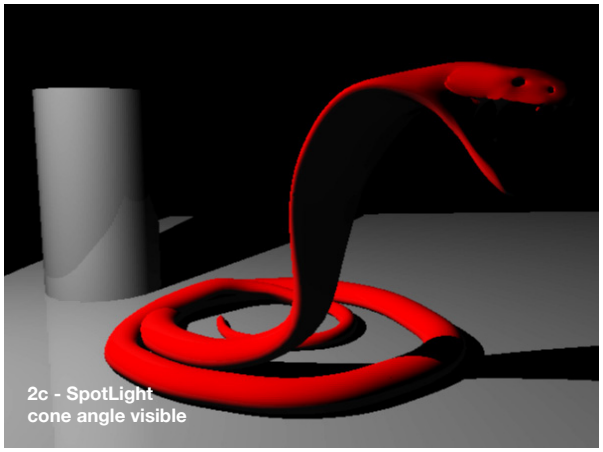
I hope this seminar will give students a quite deep understanding of the techniques and concepts used in CGI. My goal is to bring the knowledge necessary to all the players involved in the creation of hybrid images to become more and more common in today’s storytelling. **Session three** will allow the students to personally experiment with what has been taught during this seminar using Autodesk’s Maya, fostering practice after the theory.

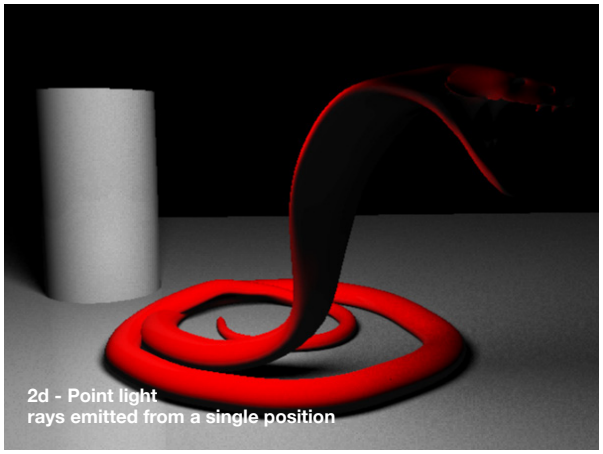
See you there.

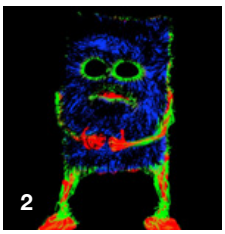
Frederic Durand


2a - Directionnal light
parrallel rays like sun


2b - Spotlight with blurry shadows
mimics a light source close to the objects


2c - SpotLight
cone angle visible


2d - Point light
rays emitted from a single position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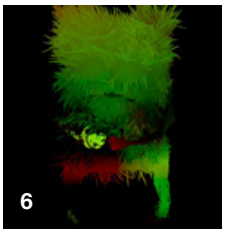
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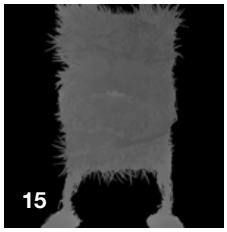
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«Electronic monitor screens connected into the system will make it possible to view the scene as it is being recorded. Control of contrast and color will be possible before development.»

Leon Shamroy, ASC, 1947