Weather Effects

Justin Neidert - Caleb Underwood - Nate Wakefield

WEATHER EFFECTS

History and Overview

Function vs. Fashion

Grand Theft Auto

- Used as decoration
- Realism is important for the GTA experience
    - Visuals and Sounds

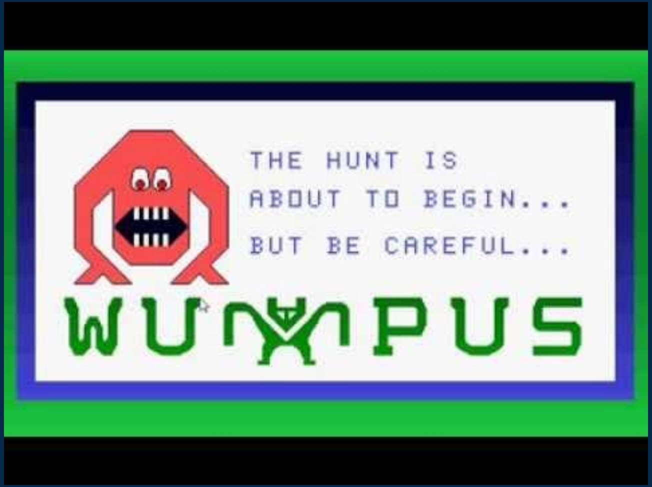
Flight Simulators

- Educational
    - Requires realistic flight conditions

1970's

- Function over Fashion
  - Minimal visual effects
  - Solely for gameplay

- Hunt the Wumpus
  - "I feel a draft."

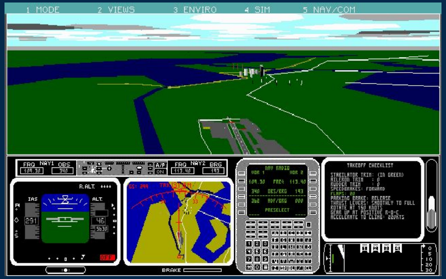


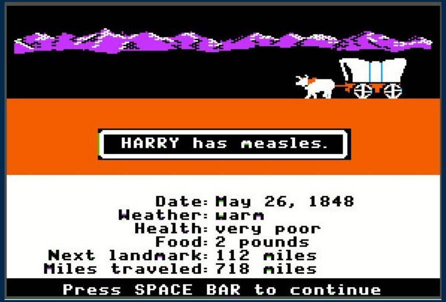
THE HUNT IS
ABOUT TO BEGIN...
BUT BE CAREFUL...

1980’s

- Function over Fashion
  - More visual effects
  - Still gameplay oriented

- Lemonade Stand
- Microsoft Flight Simulator
- Oregon Trail

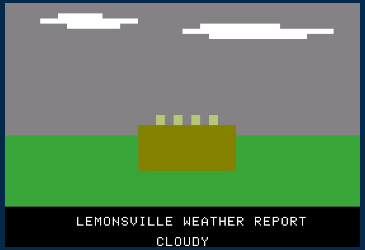




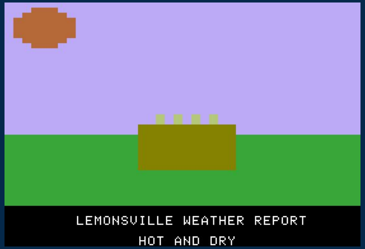
HARRY has measles.

Date: May 26, 1848
Weather: warm
Health: very poor
Food: 2 pounds
Next landmark: 112 miles
Miles traveled: 718 miles

Press SPACE BAR to continue



LEMONSVILLE WEATHER REPORT
CLOUDY



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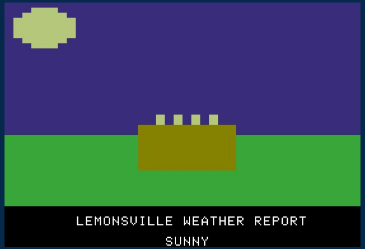
HOT AND DRY



LEMONSVILLE WEATHER REPORT
SUNNY

1990’s

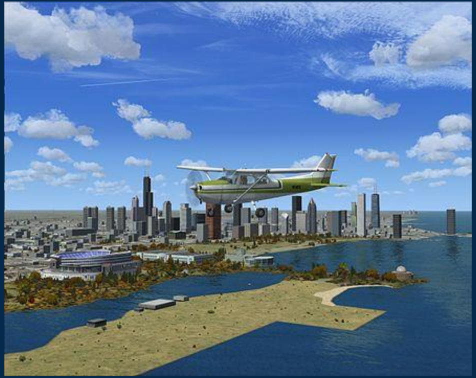
- Visual effects take the stage
  - Transition to 3D games
  - Transition to immersion

- Sled Storm
- Microsoft Flight Simulator 7
- Grand Theft Auto 2

2000’s

- Visual effects more realistic
  - Growth of immersion

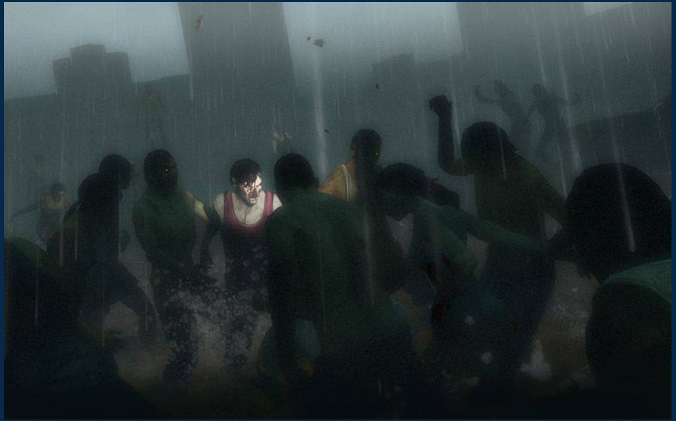
- Grand Theft Auto 3, Vice City, and San Andreas
- Microsoft Flight Simulator 10

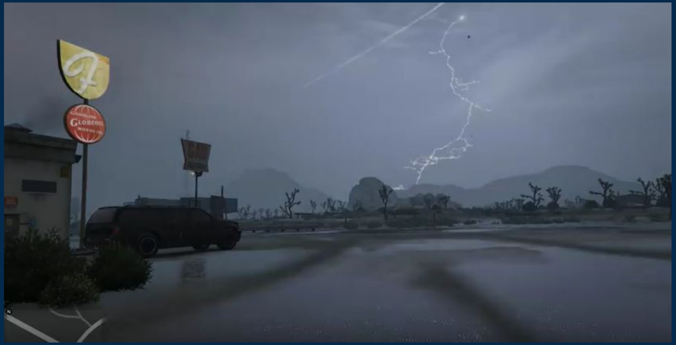


2010 to present

- Visual effects much more powerful
  - Visuals impact gameplay
  - Very effective for immersion

- Left 4 Dead
- Grand Theft Auto 4 and 5





WEATHER EFFECTS

USING UNITY

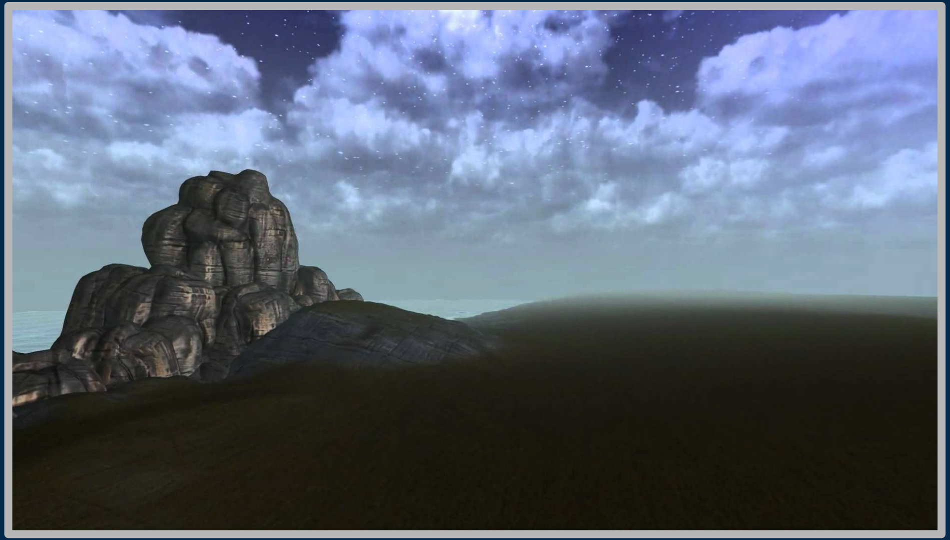
SKYBOXES, DIRECTIONAL LIGHTING AND GLOBAL ILLUMINATION

What is a Skybox?

- A ***skybox*** is a panoramic texture drawn behind all objects in the scene to represent the sky or any other vista at a great distance - Unity

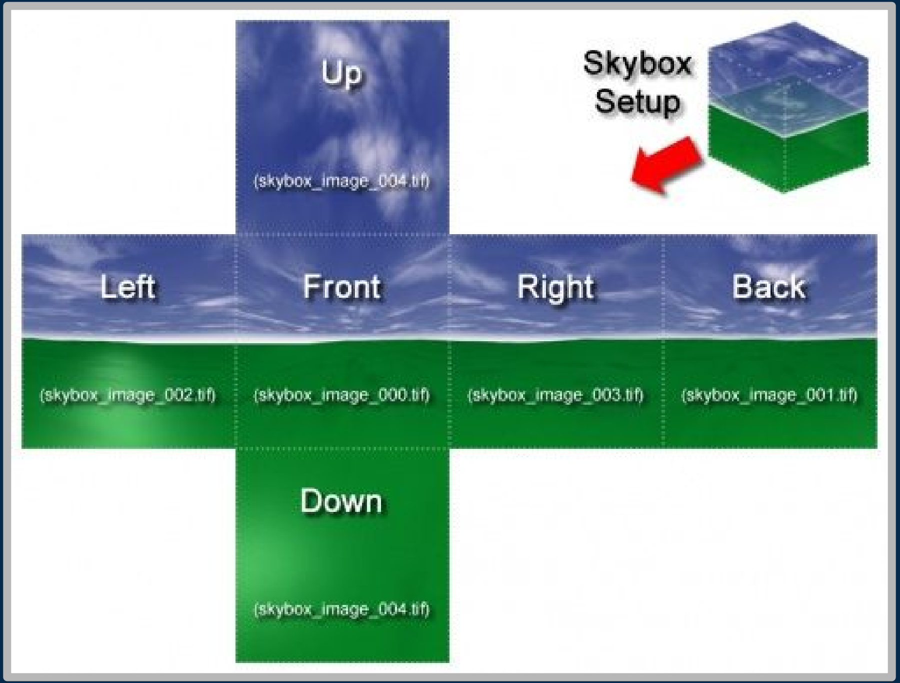
3 Types of Unity Skybox

1. 6 - Sided
2. Cubemap
3. Procedural

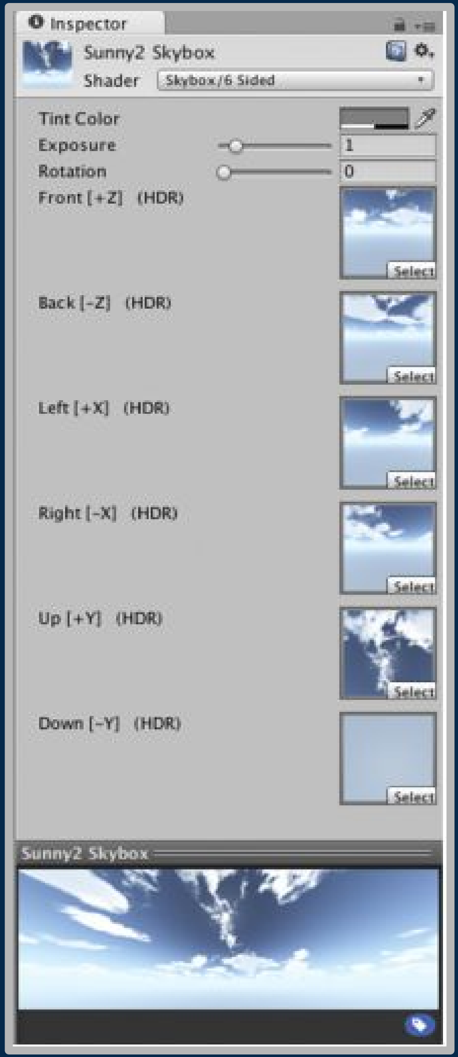


SKYBOX: 6-Sided

- A panoramic view split into six textures representing six directions visible along the up, down, left, right, front and back axes.



- Gives the illusion of a stationary sky / background



Sunny2 Skybox

Shader Skybox/6 Sided

Tint Color

Exposure 1

Rotation 0

Front [+Z] (HDR)

Back [-Z] (HDR)

Left [+X] (HDR)

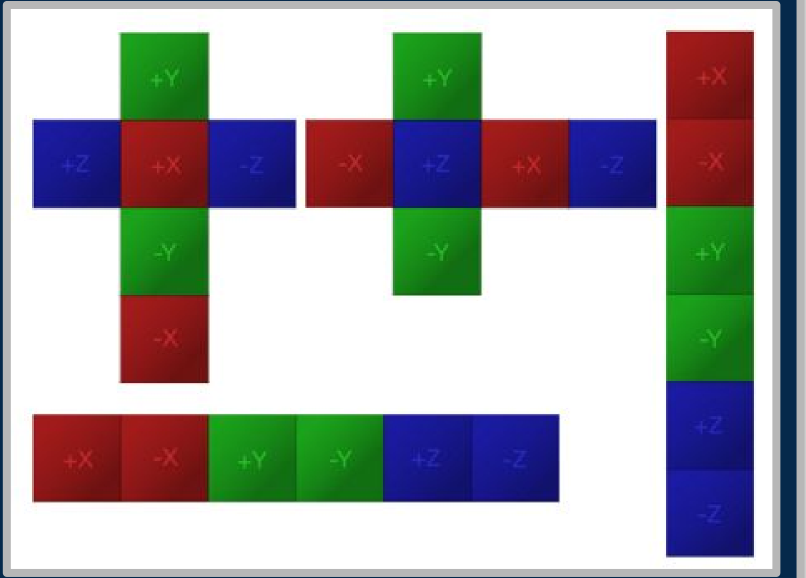
Right [-X] (HDR)

Up [+Y] (HDR)

Down [-Y] (HDR)

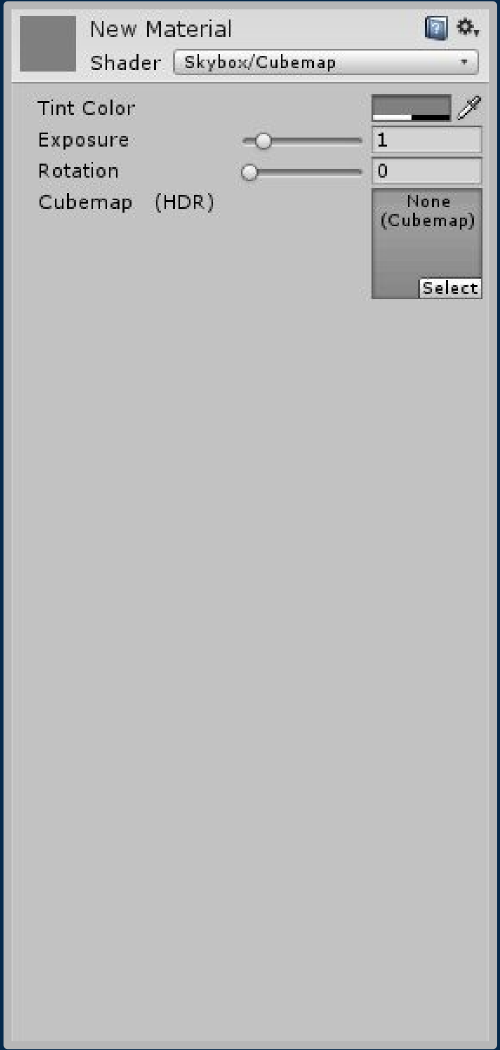
SKYBOX: Cubemap

- A collection of 6 squares that represent the reflections on an environment



Difference Between 6-Sided and Cubemap?

- *6-Sided projects information inwards*
  - *The camera is INSIDE the cube*
- *Cubemaps take surrounding information and project it back out*
  - *The camera is OUTSIDE the cube*



New Material
Shader Skybox/Cubemap

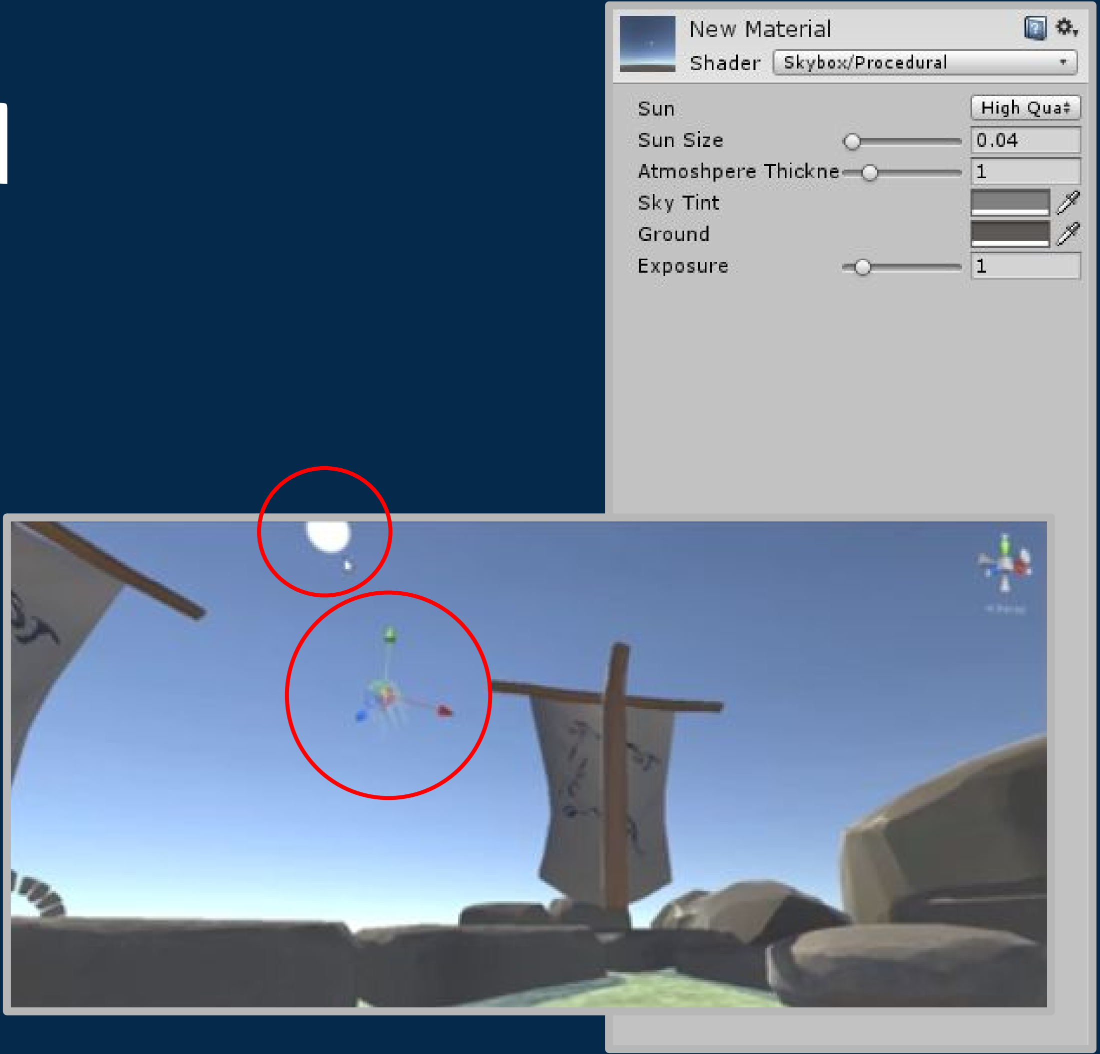
Tint Color
Exposure 1
Rotation 0
Cubemap (HDR) None (Cubemap)

SKYBOX: Procedural

- A Skybox is a source of ambient light, but it is not the primary or most intense form of light

IMPORTANT!

- For realism … have your main light source (directional light) always project in the direction of the skybox's main light source. Unity does this for you.



New Material

Shader: Skybox/Procedural

Sun: High Qua‡

Sun Size: 0.04

Atmoshpere Thickne: 1

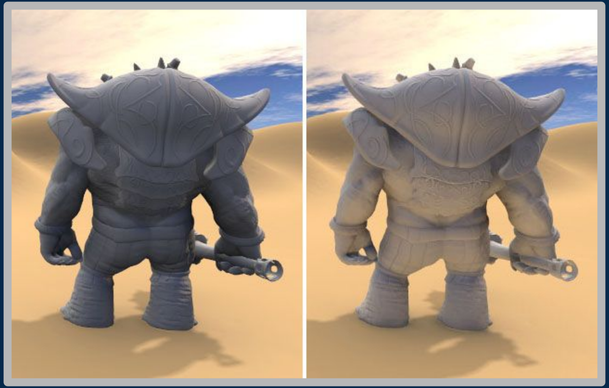
Sky Tint

Ground

Exposure: 1

Global Illumination (GI)

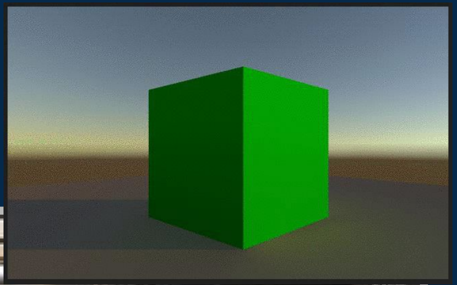
- Models how light is bounced of of surfaces onto other surfaces (indirect light)
  - Very expensive in real time

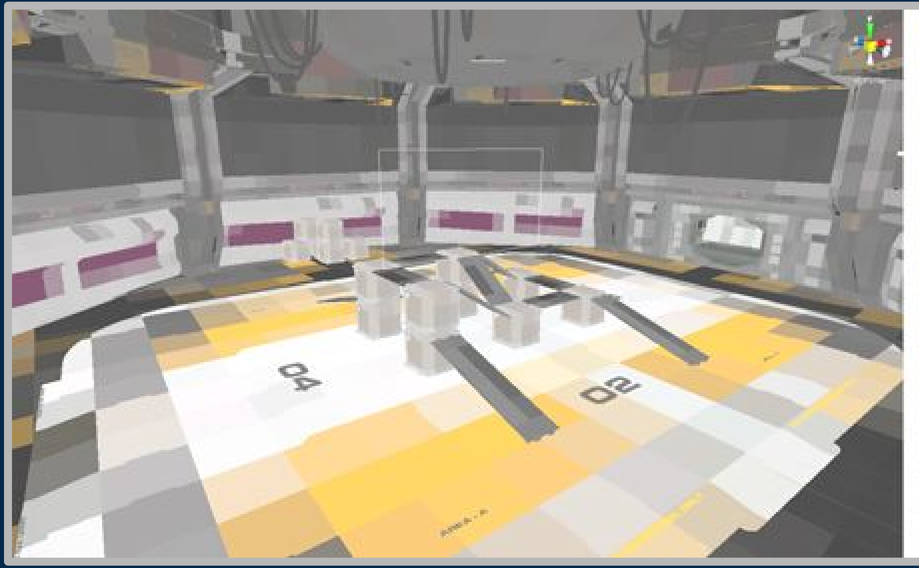


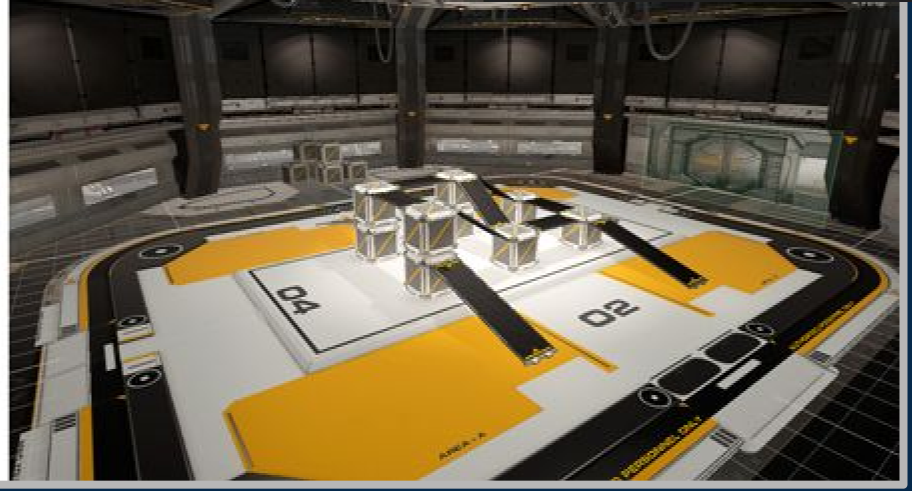
SOLUTION:

- ***Baked GI***
- ***Unity 5.0: Precomputed Realtime GI***
  - *Pre-computes ALL possible light bounces and encodes the information for use at <u>runtime</u> → static objects only*

Precomputed Realtime GI Lighting



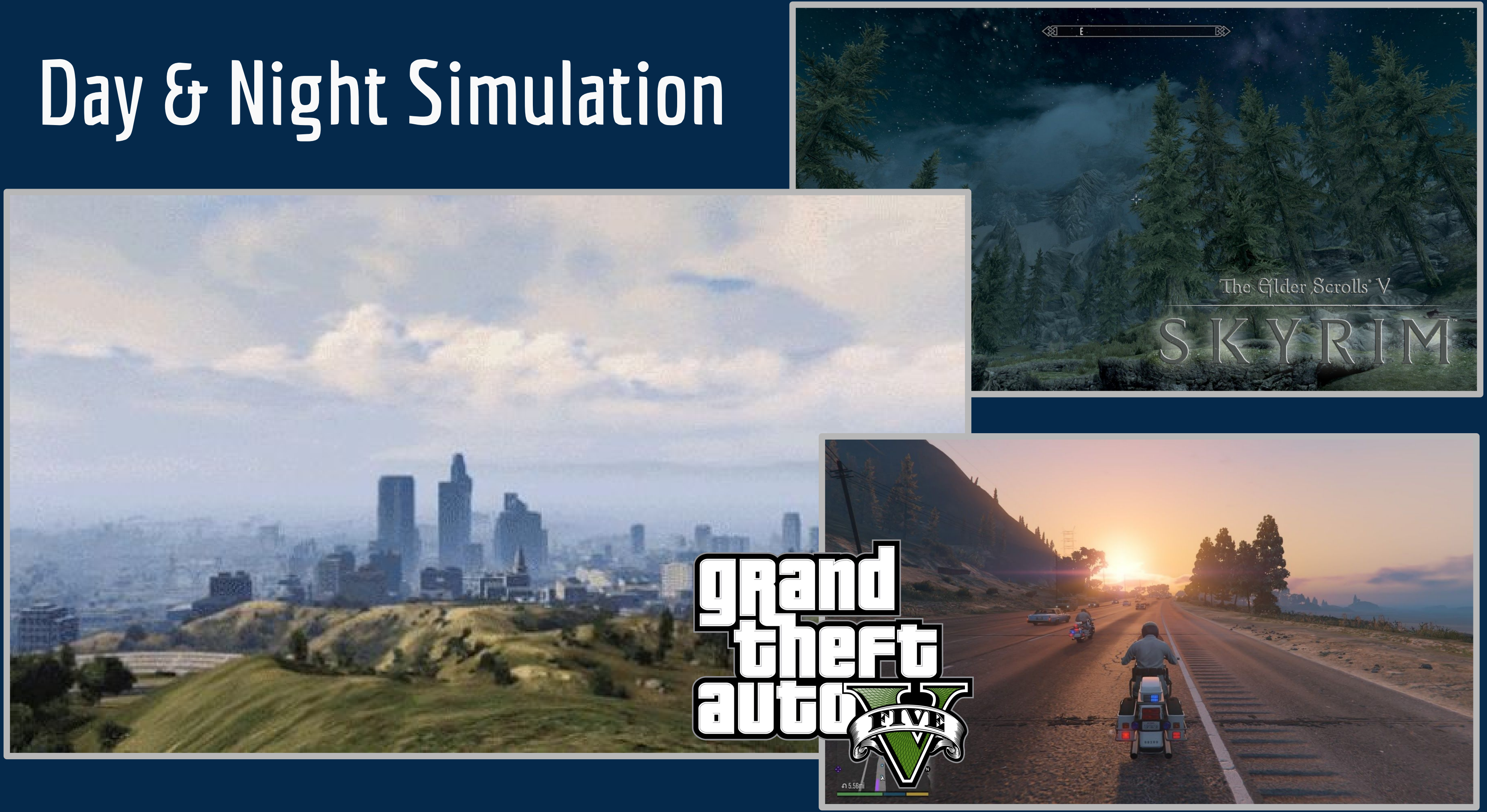




Unity first creates a low resolution approx. of the static geometry called clusters

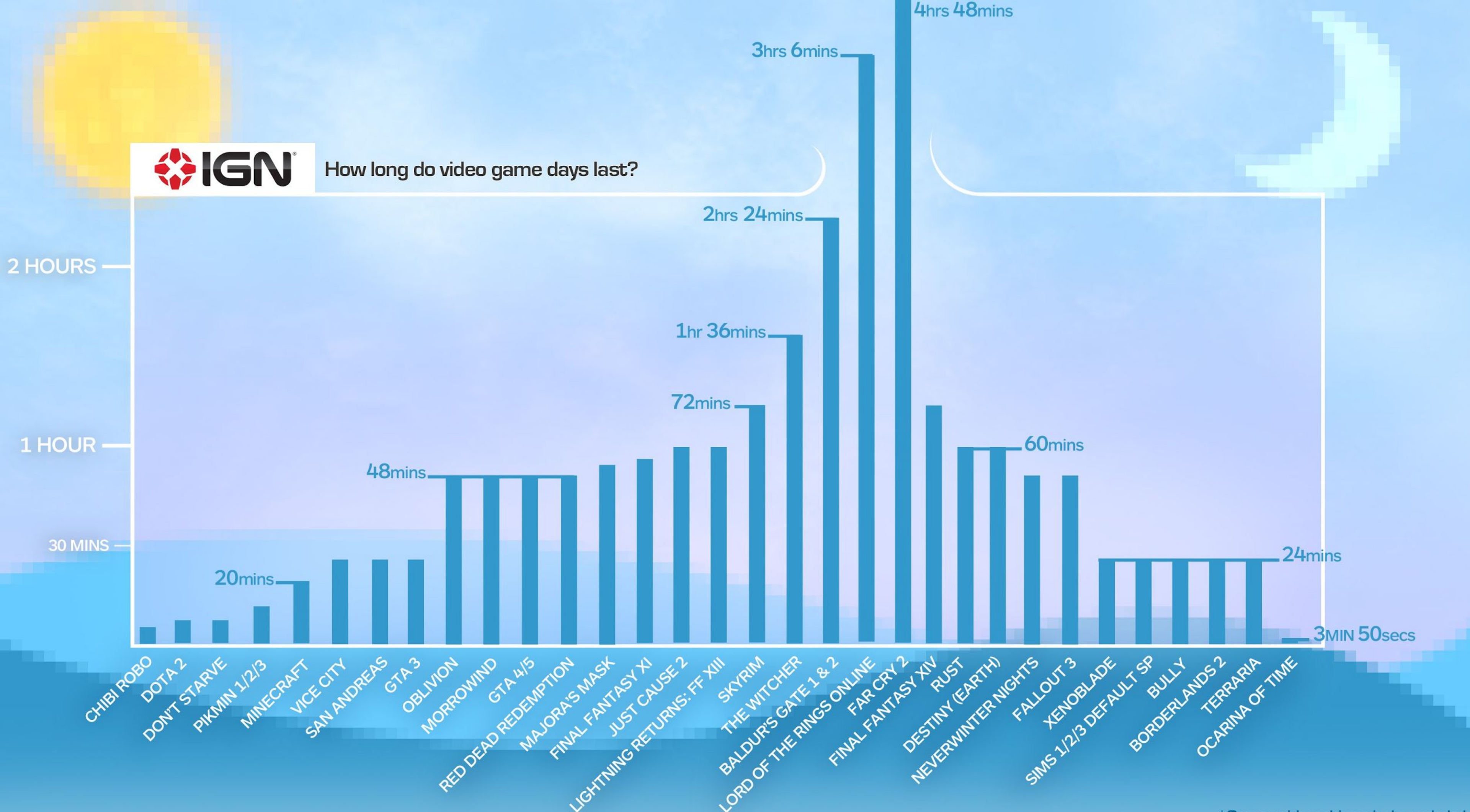
Precomputes lighting and converts to lightmap textures and applied

Day & Night Simulation



IGN

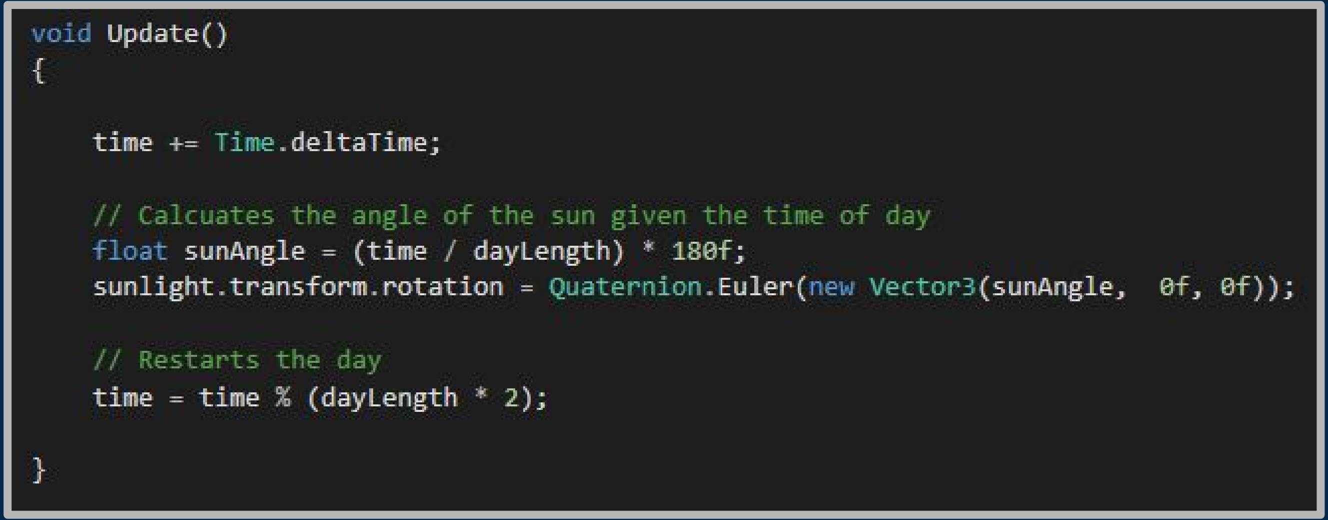
How long do video game days last?



*Games with realtime clocks excluded

Day & Night Simulation (cont.)

VERY simple example in Unity...



```
void Update()
{

    time += Time.deltaTime;

    // Calcuates the angle of the sun given the time of day
    float sunAngle = (time / dayLength) * 180f;
    sunlight.transform.rotation = Quaternion.Euler(new Vector3(sunAngle,  0f, 0f));

    // Restarts the day
    time = time % (dayLength * 2);

}
```

Where…

time → the current time in seconds

dayLength → the predefined length (in seconds) of daylight / darkness

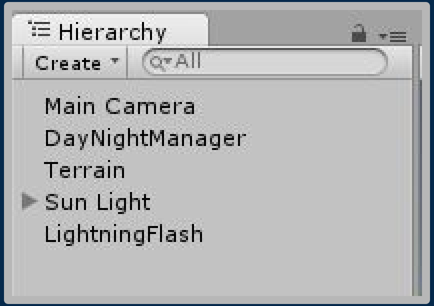
Day & Night Simulation (cont.)

Other Possible Features…

- Linear Interpolation of light intensity at dusk and dawn
  - LightSource.intensity = Mathf.Lerp(minIntensity, maxIntensity, time);
- Moon rotation at night
  - Set as child of LightSource with an offset
- Star system at night
  - ParticleSystem.Play() @ Dusk
  - ParticleSystem.Stop() @ Dawn

Lightning Flash Simulation

Lightning Flash Simulation (cont.)

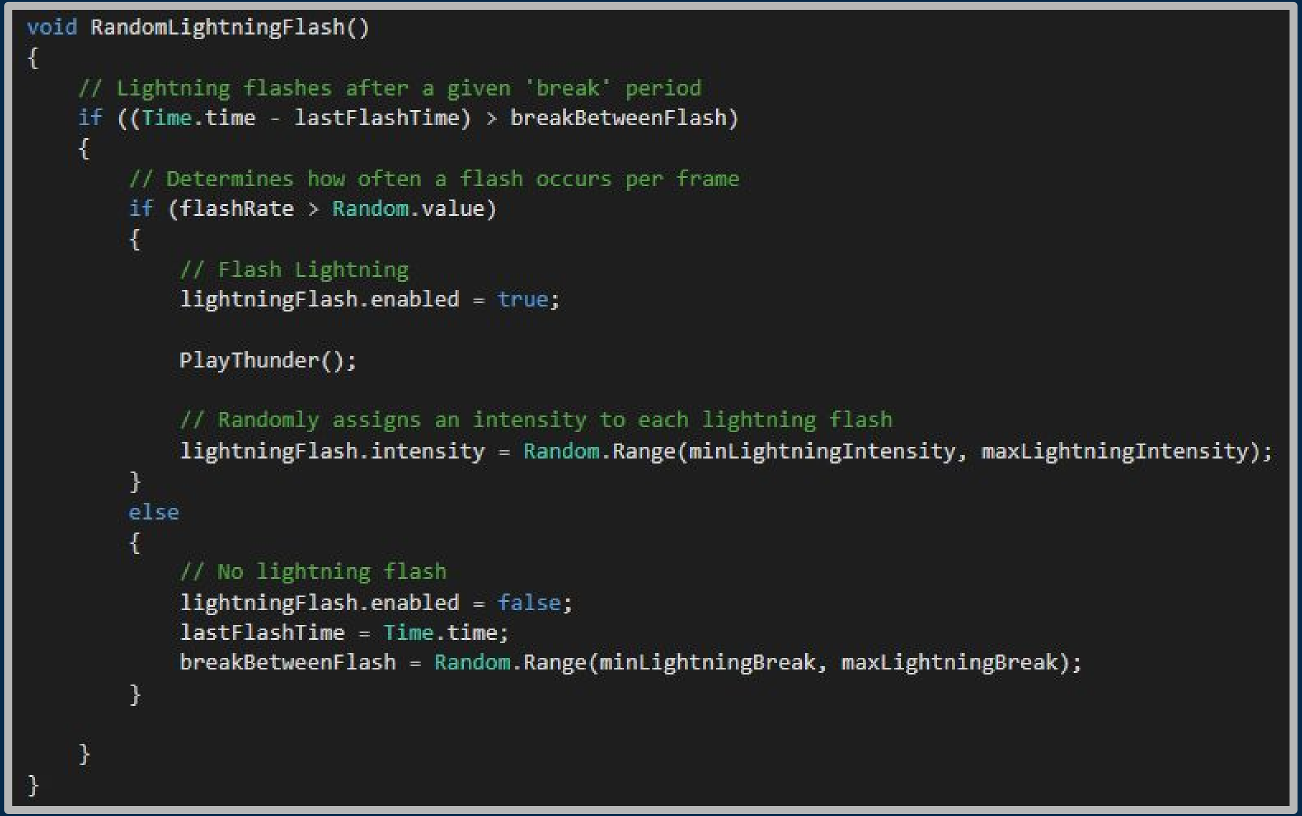


Main Camera
DayNightManager
Terrain
Sun Light
LightningFlash

Simple way to achieve this effect…

- Drop an additional directional light into your scene
- Activate / deactivate each time a flash occurs
  - Unity's Global Illumination takes action, simulating a real lightning storm!

Lightning Flash Simulation (cont.)



```
void RandomLightningFlash()
{
    // Lightning flashes after a given 'break' period
    if ((Time.time - lastFlashTime) > breakBetweenFlash)
    {
        // Determines how often a flash occurs per frame
        if (flashRate > Random.value)
        {
            // Flash Lightning
            lightningFlash.enabled = true;

            PlayThunder();

            // Randomly assigns an intensity to each lightning flash
            lightningFlash.intensity = Random.Range(minLightningIntensity, maxLightningIntensity);
        }
        else
        {
            // No lightning flash
            lightningFlash.enabled = false;
            lastFlashTime = Time.time;
            breakBetweenFlash = Random.Range(minLightningBreak, maxLightningBreak);
        }

    }
}
```

DEMO

Day/Night & Lightning Flash Simulations

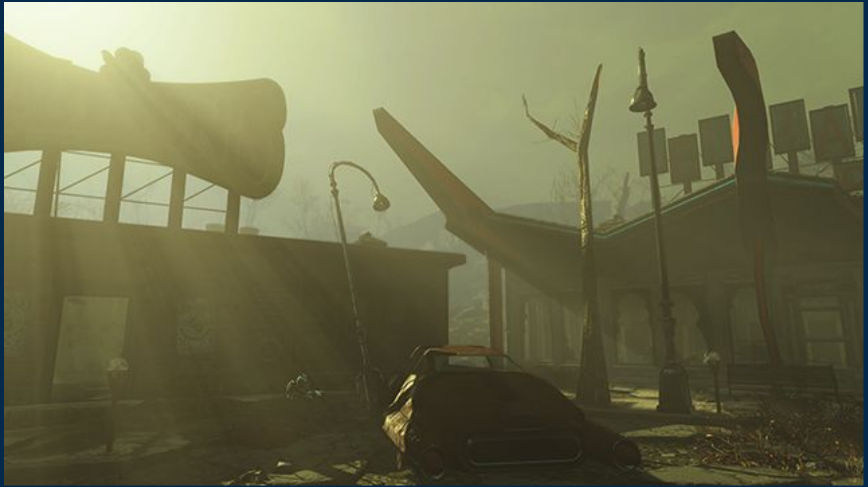
Volumetric Lighting

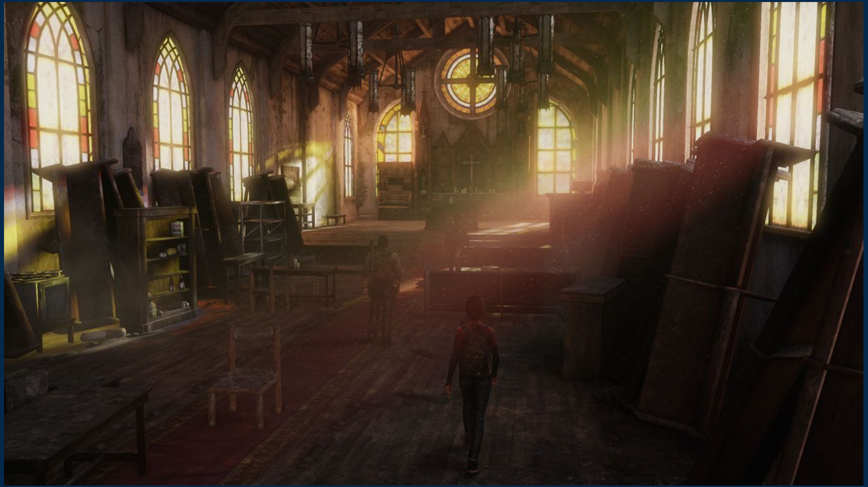
What is volumetric lighting?

- In the real world, the air is not usually crystal clear. There is fog, water vapor, smoke, dust and other particles floating in the air.
- This concept creates sections of illuminated air referred to as sunbeams or god rays, or technically, crepuscular rays.
- These are most noticeable in sporadically shaded environments, such as forests, through windows, or from behind clouds

Seen in many games

- As games strive further and further for realism, the concept of god rays and dynamic sunbeams has been implemented in many recent games, specifically those that have dynamic weather effect (ie, fog, radiation storms) or those that take place in dusty abandoned buildings.





Additional uses

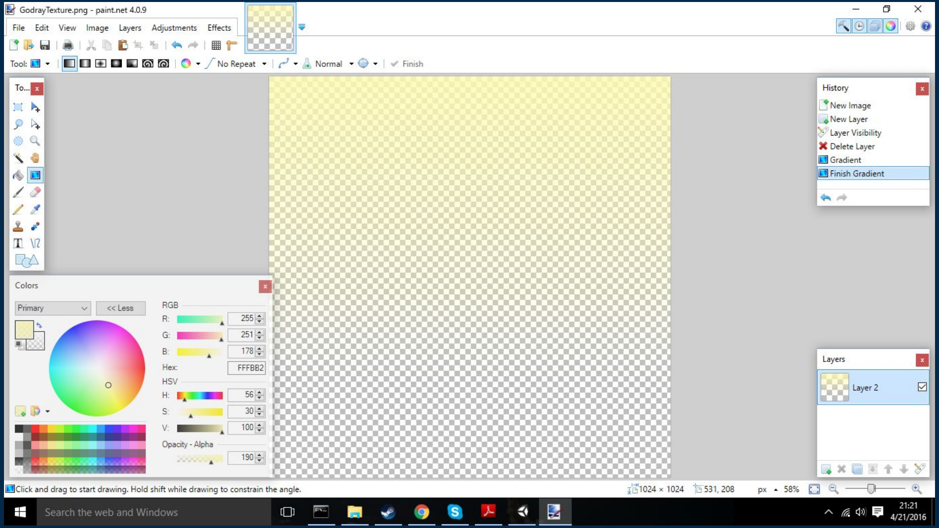
- In addition to weather effects, volumetric lighting can serve other purposes as well
- They can often enhance the effects of artificial lighting as well as make spotlights more dramatic

Important note

- Before we begin talking about the implementation process, it is important to understand that volumetric lighting is a lighting *effect*. It is not illumination itself. Don’t forget to place actual lighting in your scene!

Step one: defining a gradient

- Most photo editing software allows for the use of gradation. In this example I simply used paint.net to create a simple light yellow-transparent gradation. Remember transparent texture is defined by low alpha (opacity)
- Usually you want to have a very transparent gradient. Typically, the alpha should be <200 at the most opaque part. I recommend not applying a gradient to the entire frame or else the boundaries of the god ray become very distinct (usually you want It to be a softer transition)



GodrayTexture.png - paint.net 4.0.9

Colors

Primary

RGB

R: 255

G: 251

B: 178

Hex: FFFBB2

HSV

H: 56

S: 30

V: 100

Opacity - Alpha

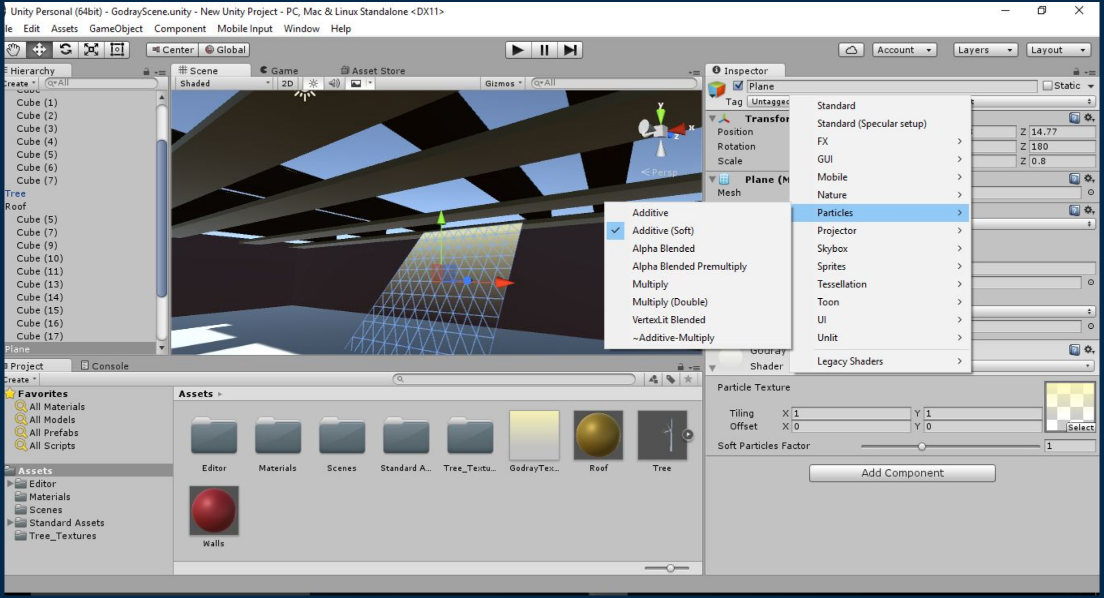
190

Click and drag to start drawing. Hold shift while drawing to constrain the angle.

1024 × 1024   531, 208   px   58%

Step two: applying it (it's that easy)

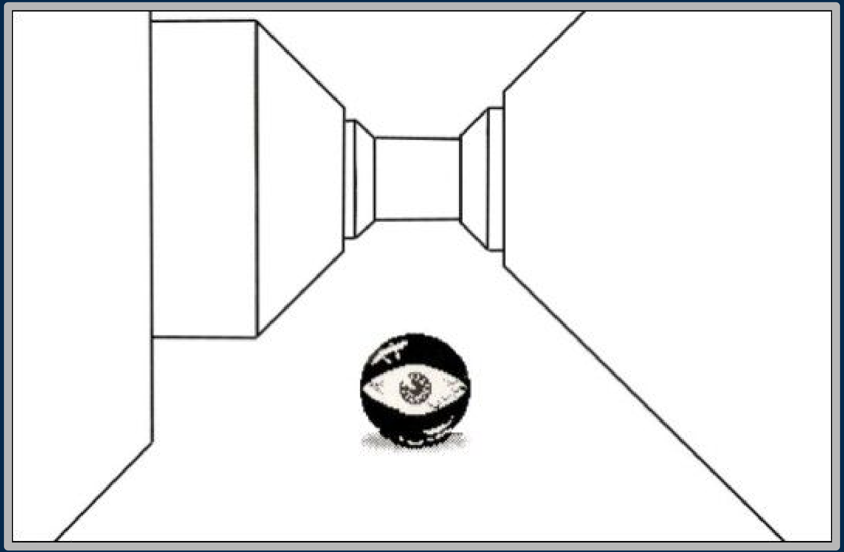
- Simply drag and drop you texture in Unity
- IMPORTANT: remember to change the shader from “standard” to “particles/additive (soft)” or else there will just be a gradation of the default material.
- As you can see, volumetric lighting is incredible simple to implement and provides for much more realistic lighting/weather effects



DEMO

Showing manual godray texturing and Unity’s own auto-sunbeam script

QUESTIONS?



YOU GUYS THOUGHT WE FORGOT; DIDN’T YOU?