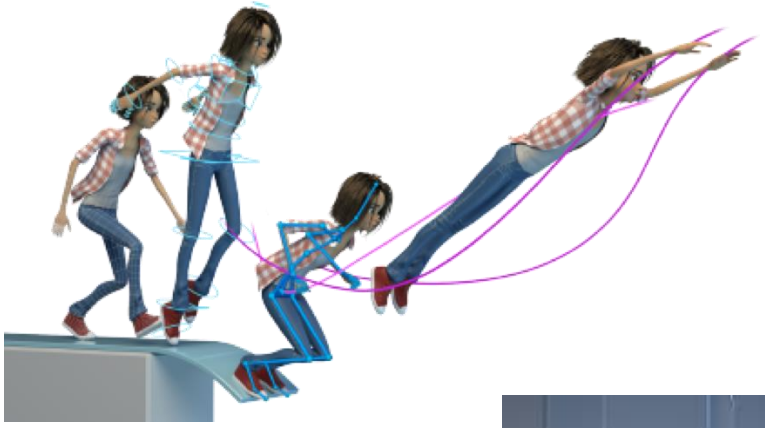
Animation (with Blender)

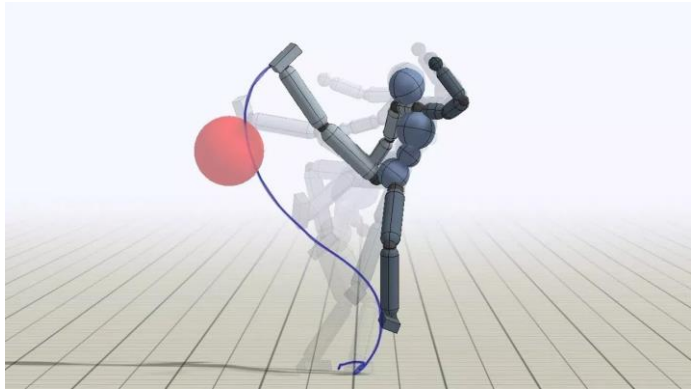
Multimedia Techniques & Applications

Yu-Ting Wu

Recap.

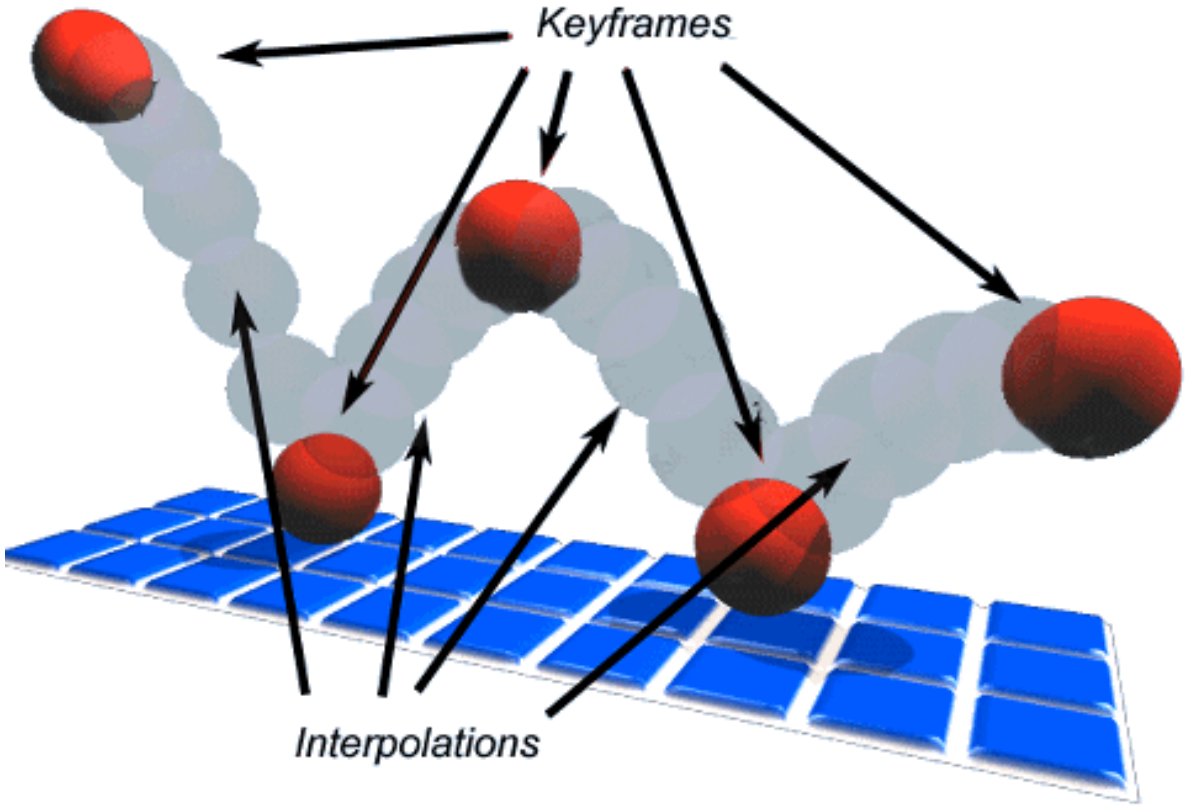
- **The goal of animation:**
  - Describe how do geometry/objects change/move with time





Recap.

- **Keyframe Interpolation**

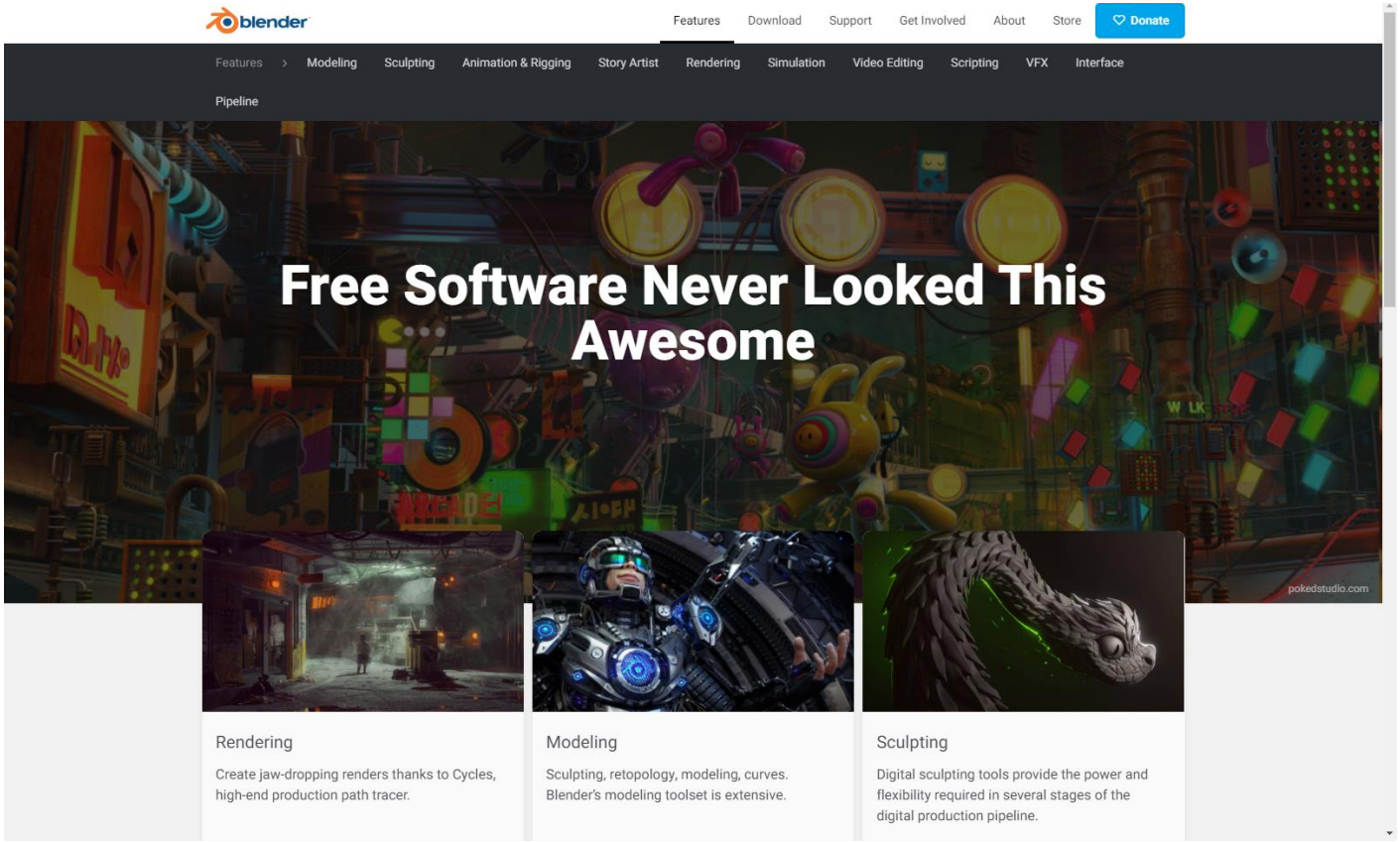


This Week's Course

- We will introduce the minimal knowledges for creating an animation in **Blender**
  - Remember it is better to add "virtual objects" in your final project
  - We will introduce:
    - Basic operations
    - 3D models loading
    - Materials and lighting
    - Keyframes insertion
    - Animation rendering
- There are lots of resources on the internet !

blender

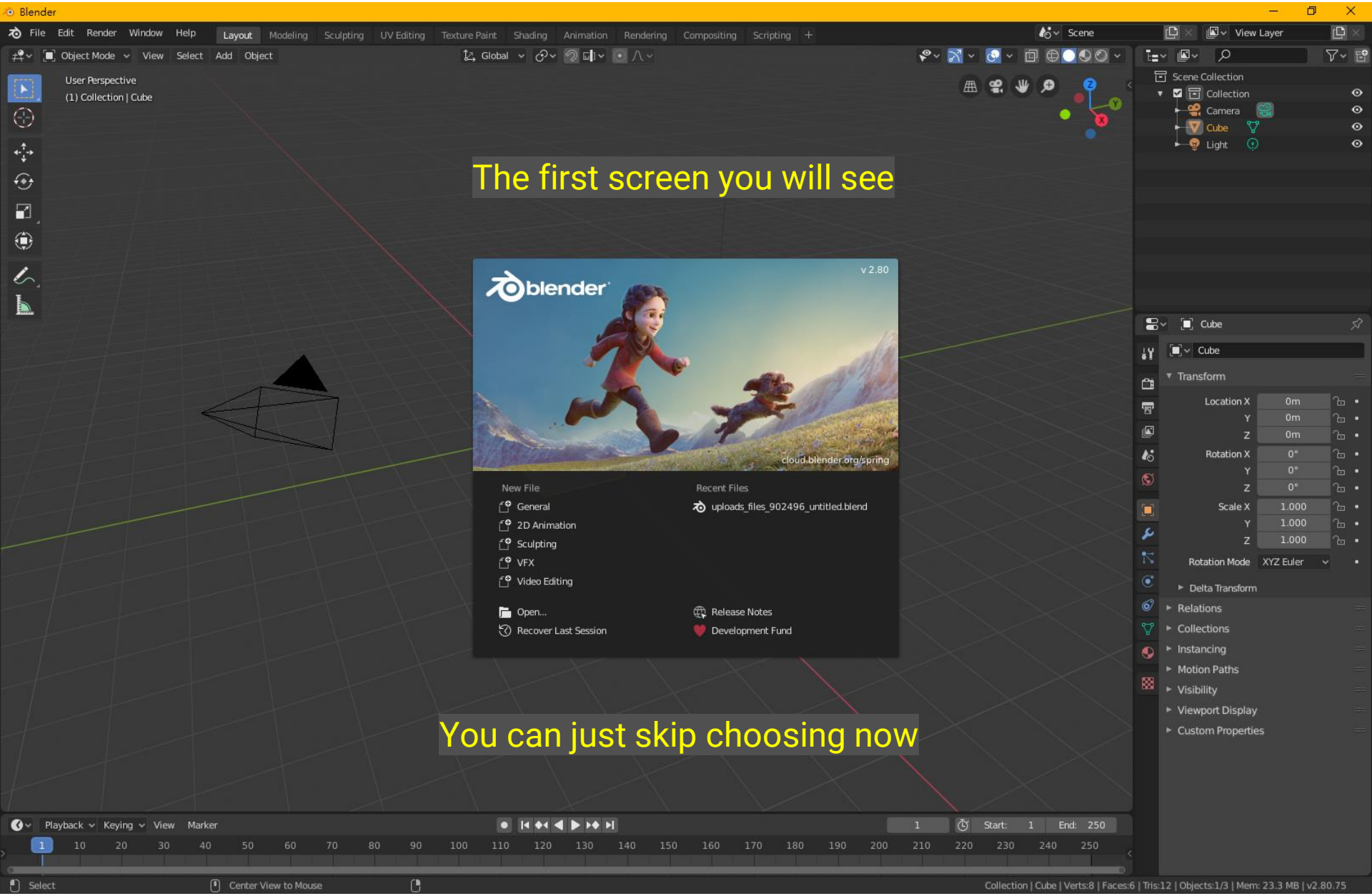
- One of the most popular professional **modeling tool**
- Most important, it is **free**!

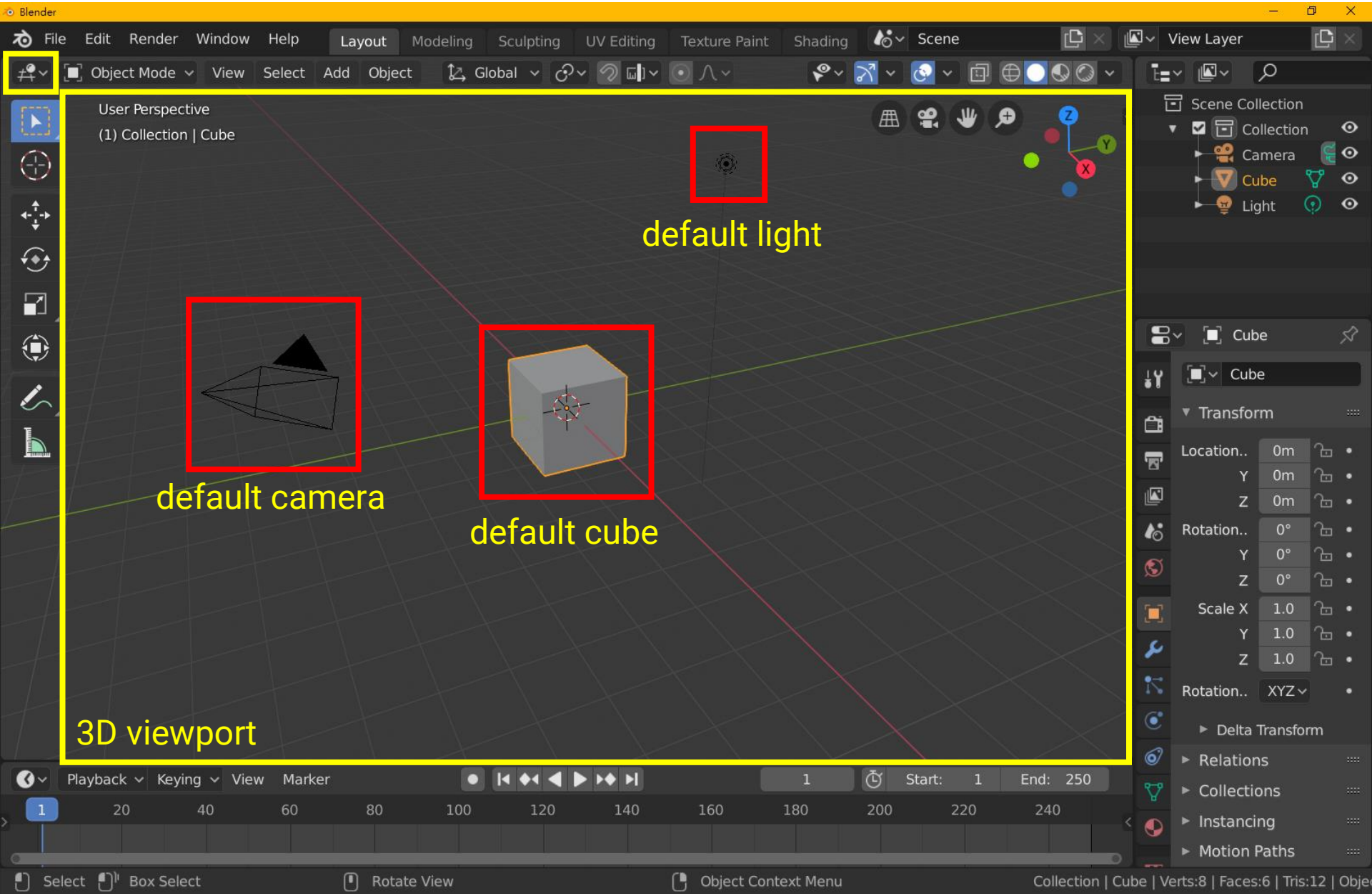


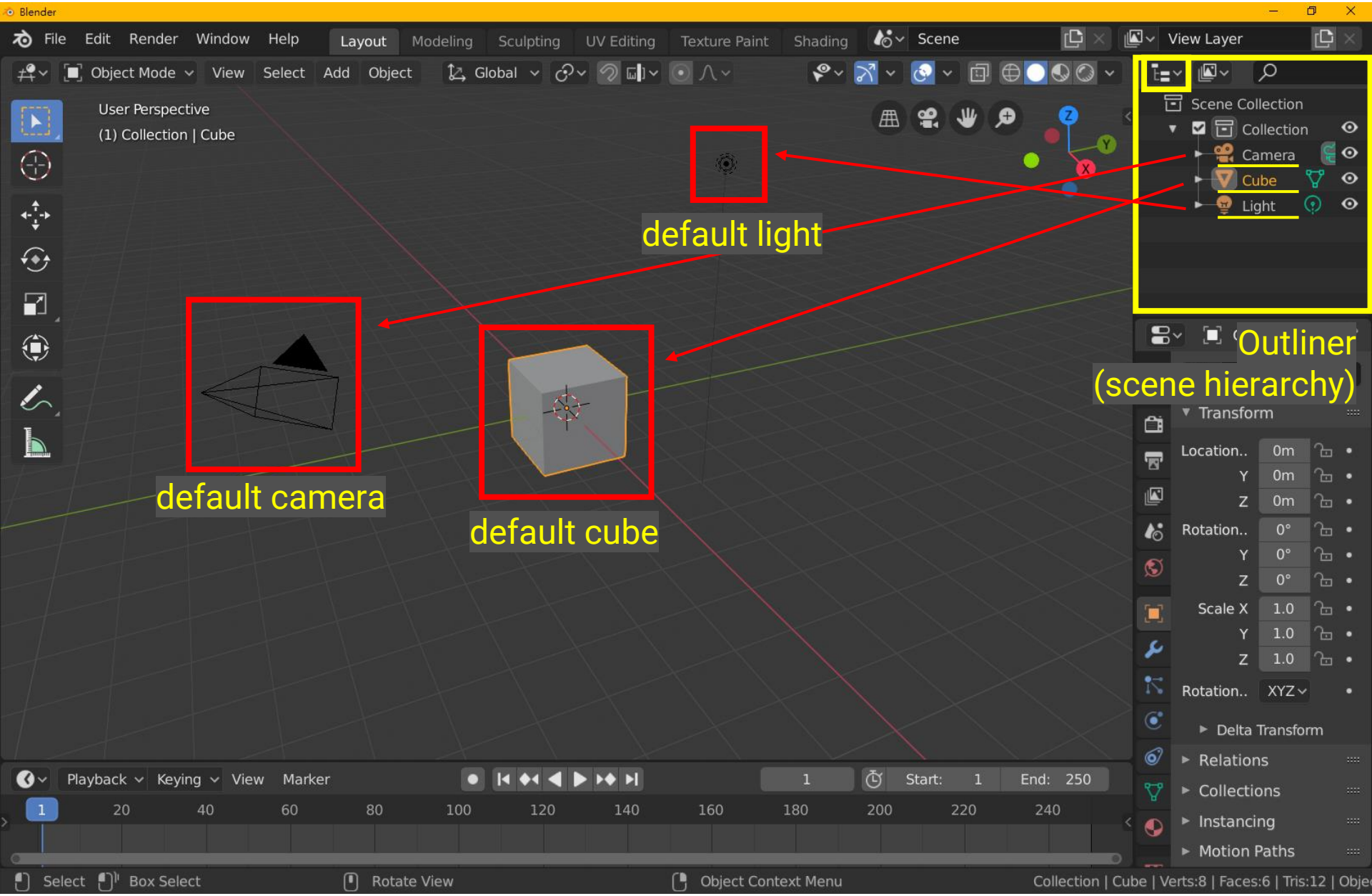
Installation

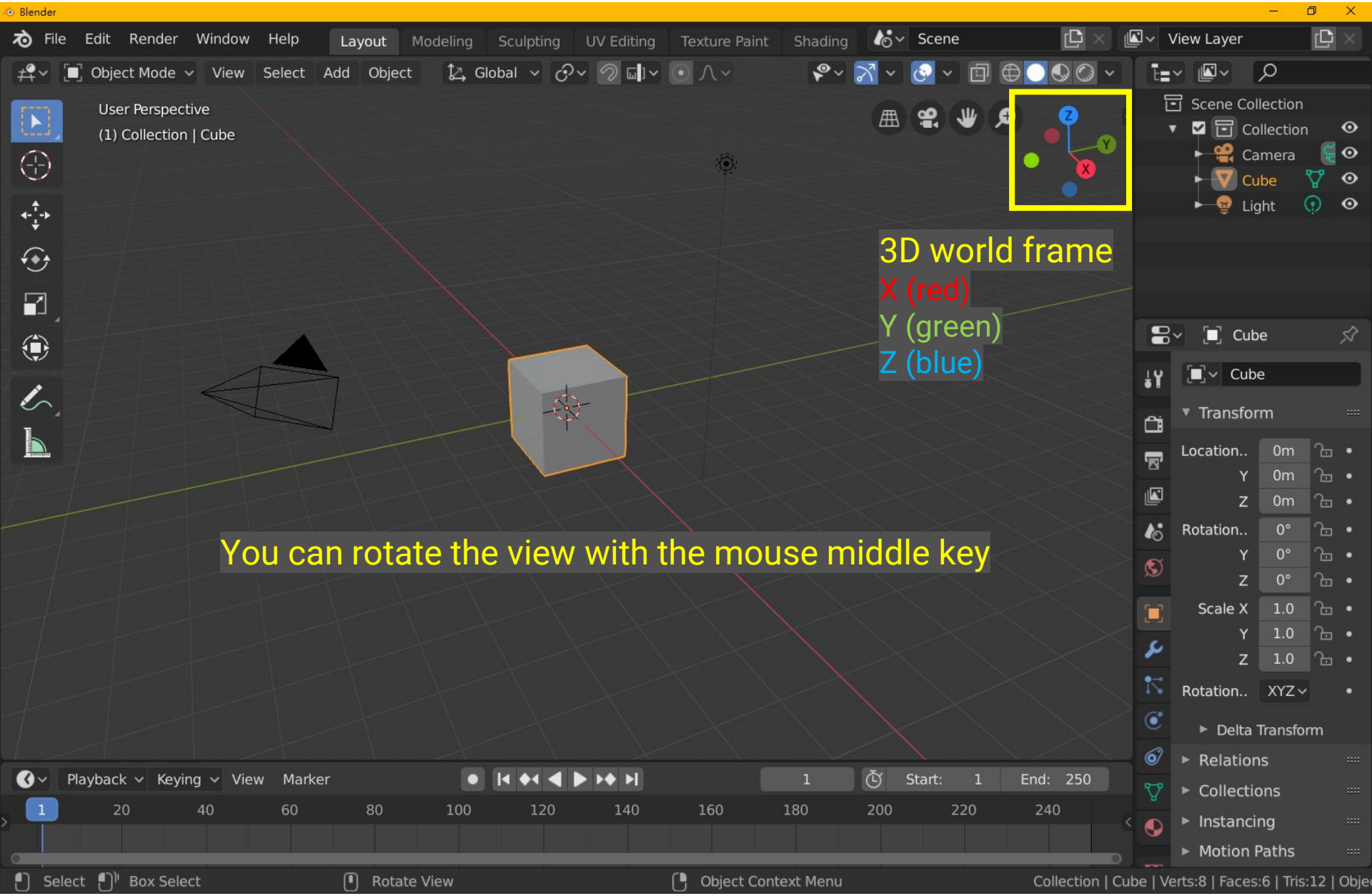
- The newest version: 3.1
- However, I suggested to install **ver. 2.80** because it is guaranteed to work for **Matchmove**, which will be taught next week
  - https://download.blender.org/release/Blender2.80/
- TA has also installed Blender ver. 2.80 on the computers in the classroom (B1F-04)

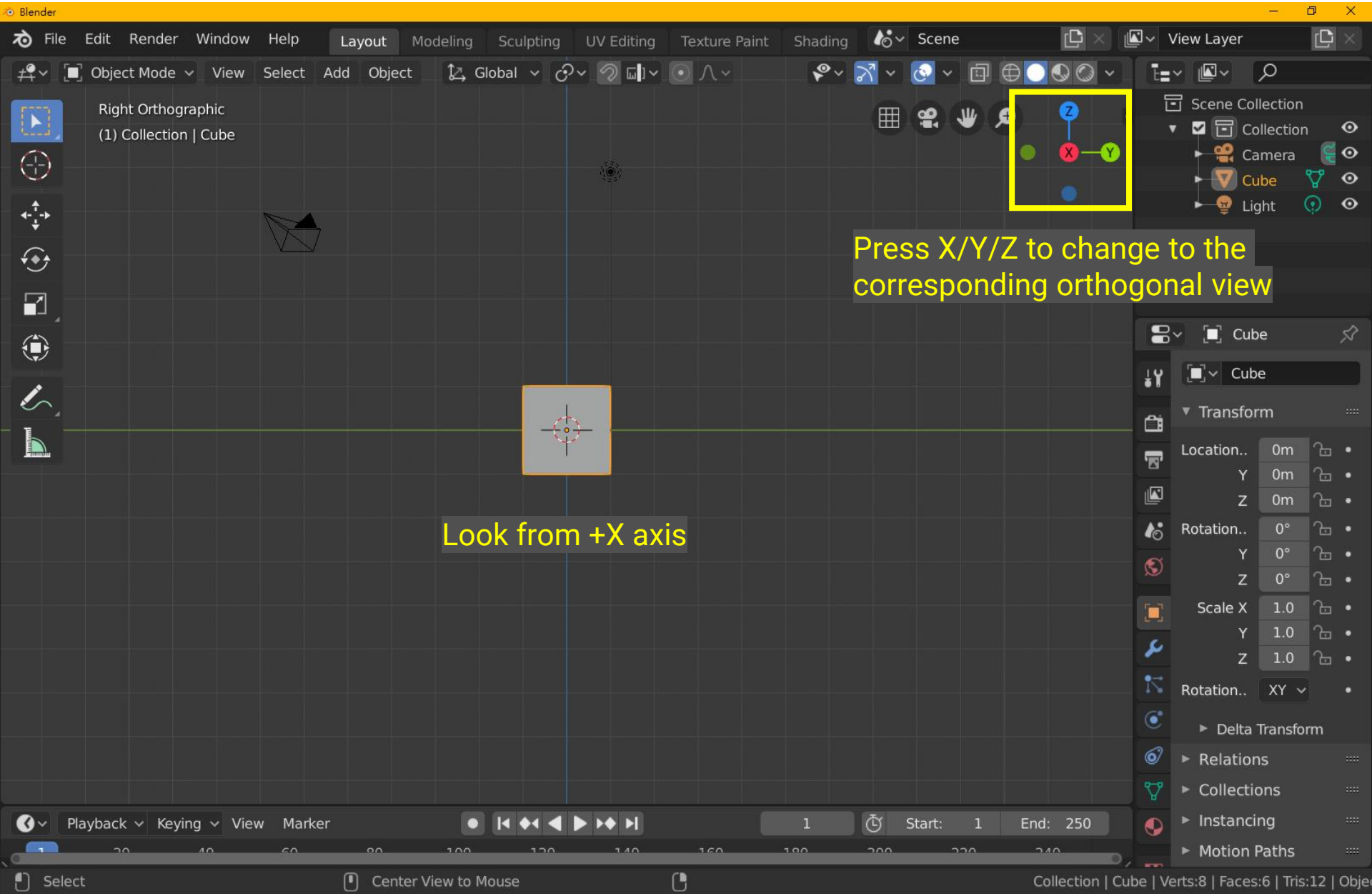
Blender Editor Overview

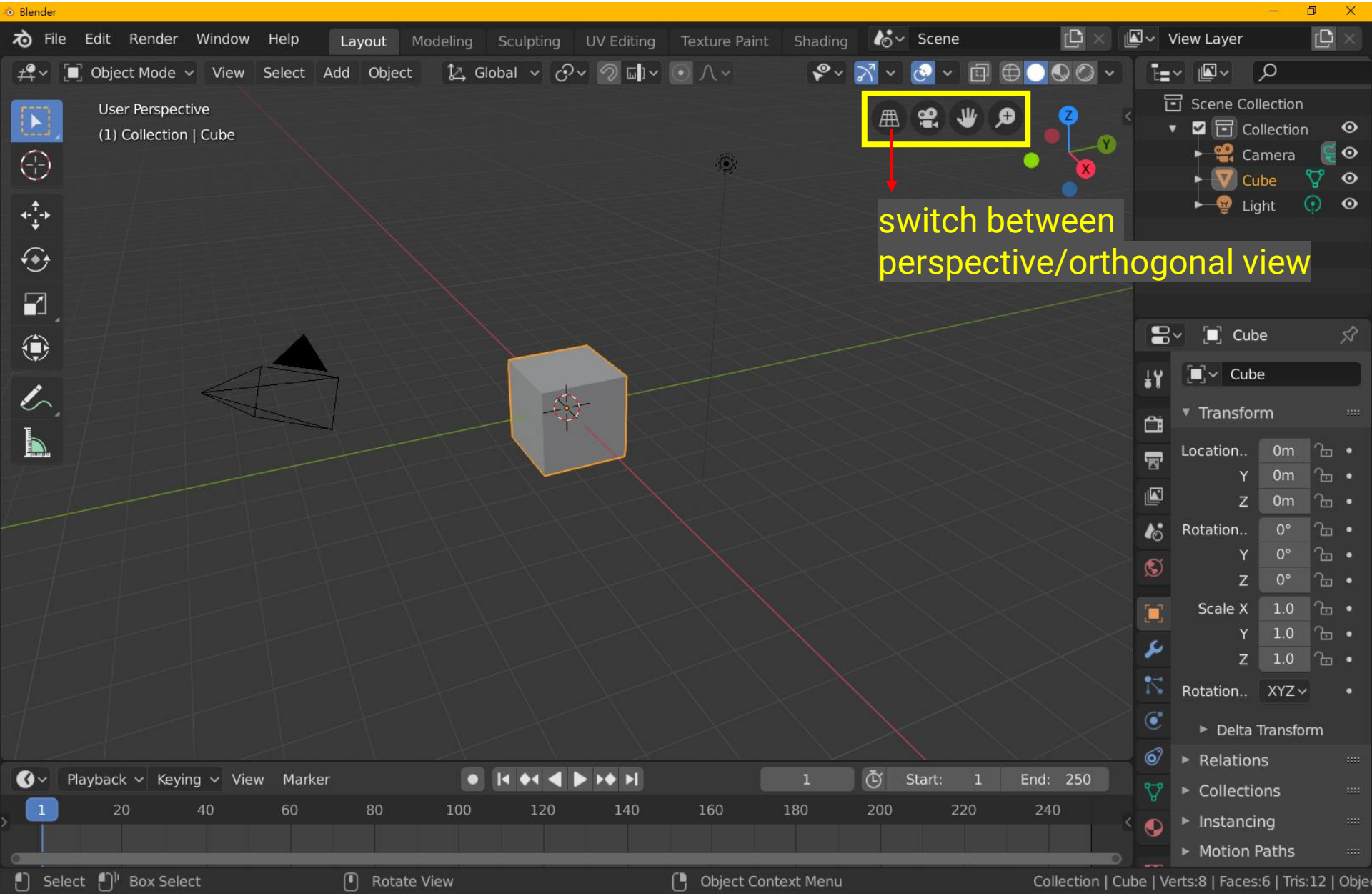

Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Cube
Scene Collection
Collection
Camera
Cube
Light
The first screen you will see
blender
v 2.80
cloud.blender.org/spring
New File
General
2D Animation
Sculpting
VFX
Video Editing
Open...
Recover Last Session
Recent Files
uploads_files_902496_untitled.blend
Release Notes
Development Fund
You can just skip choosing now
Cube
Transform
Location X 0m
Y 0m
Z 0m
Rotation X 0°
Y 0°
Z 0°
Scale X 1.000
Y 1.000
Z 1.000
Rotation Mode XYZ Euler
Delta Transform
Relations
Collections
Instancing
Motion Paths
Visibility
Viewport Display
Custom Properties
Playback Keying View Marker
Start: 1 End: 250
Select
Center View to Mouse
Collection | Cube | Verts:8 | Faces:6 | Tris:12 | Objects:1/3 | Mem: 23.3 MB | v2.80.75


Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint Shading
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Cube
default light
default camera
default cube
3D viewport
Scene Collection
Collection
Camera
Cube
Light
Cube
Transform
Location..
Rotation..
Scale X
Rotation..
XYZ
Delta Transform
Relations
Collections
Instancing
Motion Paths
Playback Keying View Marker
Start: 1
End: 250
Select
Box Select
Rotate View
Object Context Menu
Collection | Cube | Verts:8 | Faces:6 | Tris:12

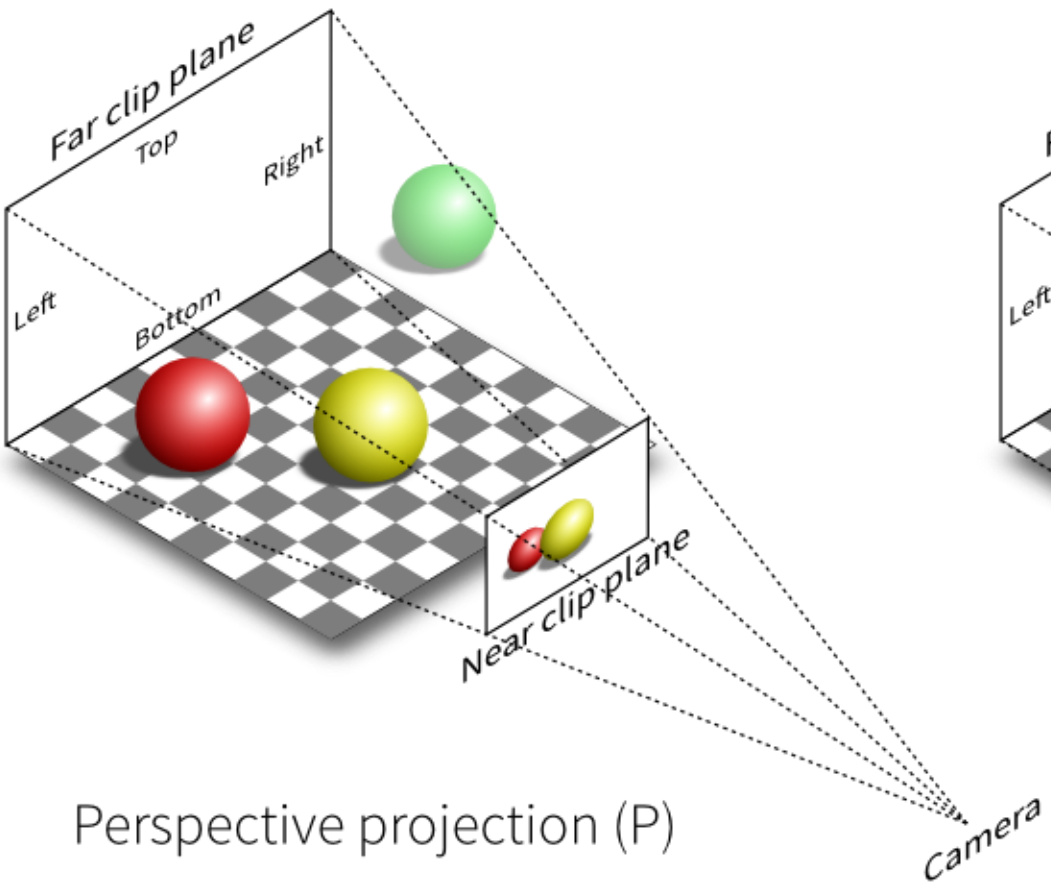

Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint Shading
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Cube
Scene Collection
Collection
Camera
Cube
Light
default light
default camera
default cube
Outliner
(scene hierarchy)
Transform
Location..
Rotation..
Scale X
Rotation..
XYZ
Delta Transform
Relations
Collections
Instancing
Motion Paths
Playback Keying View Marker
Start: 1
End: 250
Select
Box Select
Rotate View
Object Context Menu
Collection | Cube | Verts:8 | Faces:6 | Tris:12


Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint Shading
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Cube
Scene Collection
Collection
Camera
Cube
Light
3D world frame
X (red)
Y (green)
Z (blue)
You can rotate the view with the mouse middle key
Cube
Transform
Location..
Rotation..
Scale X
Delta Transform
Relations
Collections
Instancing
Motion Paths
Playback Keying View Marker
Start: 1
End: 250
Select
Box Select
Rotate View
Object Context Menu
Collection | Cube | Verts:8 | Faces:6 | Tris:12

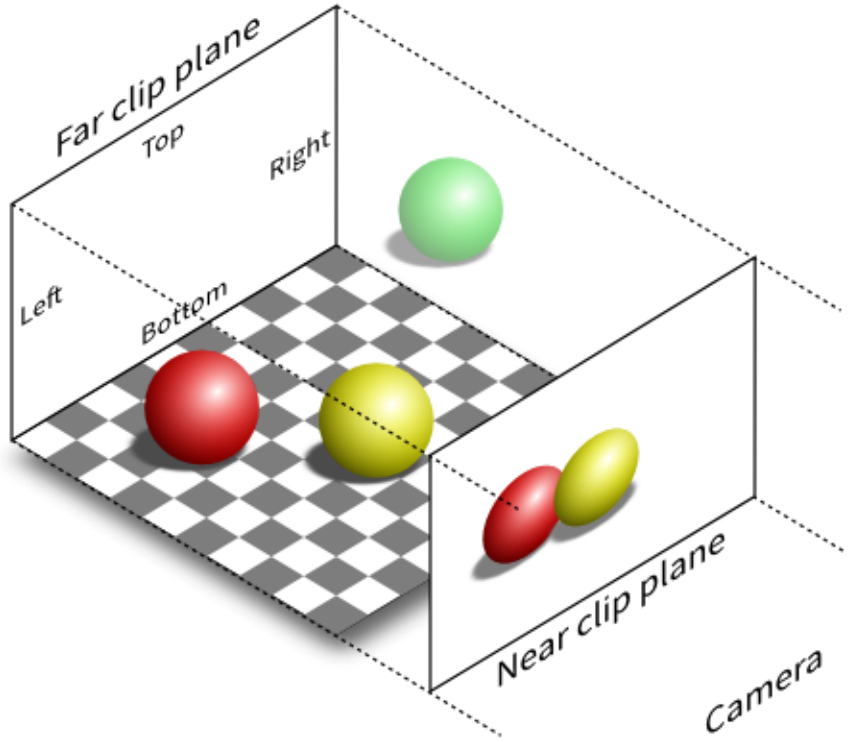

Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint Shading
Scene
View Layer
Object Mode View Select Add Object
Global
Right Orthographic
(1) Collection | Cube
Scene Collection
Collection
Camera
Cube
Light
Press X/Y/Z to change to the corresponding orthogonal view
Look from +X axis
Cube
Transform
Location.. 0m
Y 0m
Z 0m
Rotation.. 0°
Y 0°
Z 0°
Scale X 1.0
Y 1.0
Z 1.0
Rotation.. XY
Delta Transform
Relations
Collections
Instancing
Motion Paths
Playback Keying View Marker
1
Start: 1
End: 250
Select
Center View to Mouse
Collection | Cube | Verts:8 | Faces:6 | Tris:12


Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint Shading
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Cube
switch between
perspective/orthogonal view
Scene Collection
Collection
Camera
Cube
Light
Cube
Transform
Location..
Rotation..
Scale X
Rotation..
XYZ
Delta Transform
Relations
Collections
Instancing
Motion Paths
Playback Keying View Marker
Start: 1
End: 250
Select
Box Select
Rotate View
Object Context Menu
Collection | Cube | Verts:8 | Faces:6 | Tris:12

What is Orthogonal Projection



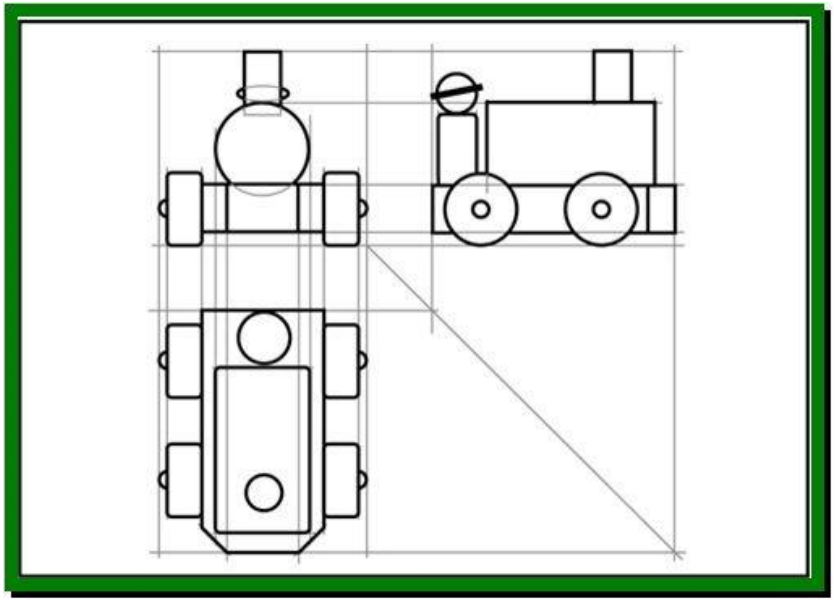
Perspective projection (P)

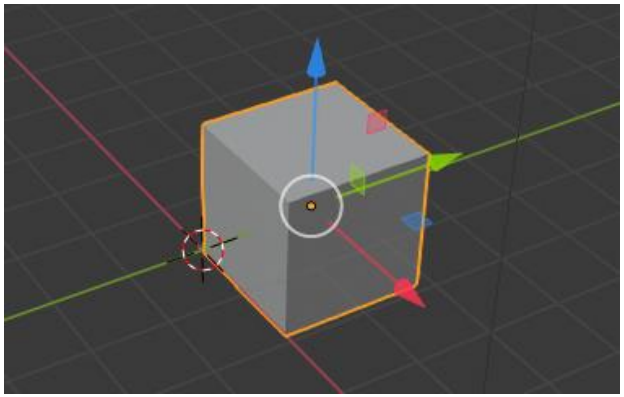


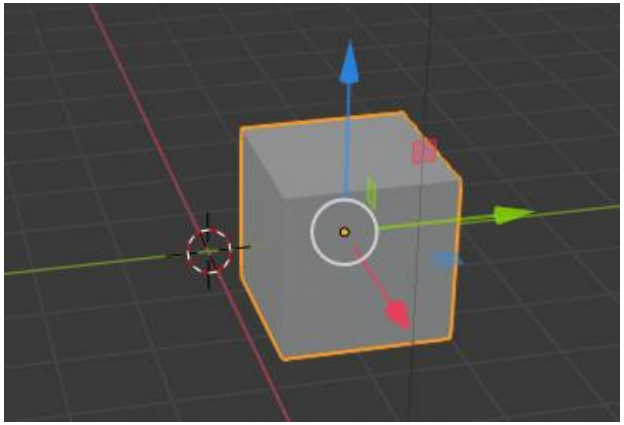
Orthographic projection (O)

Why Orthogonal Projection

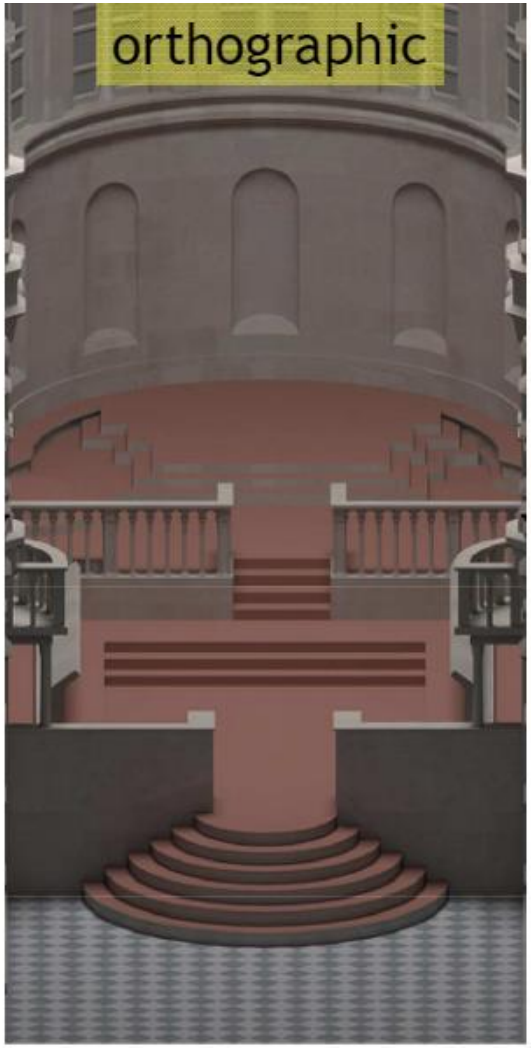
- Sometimes it is easier to make the geometry right in the orthogonal projection

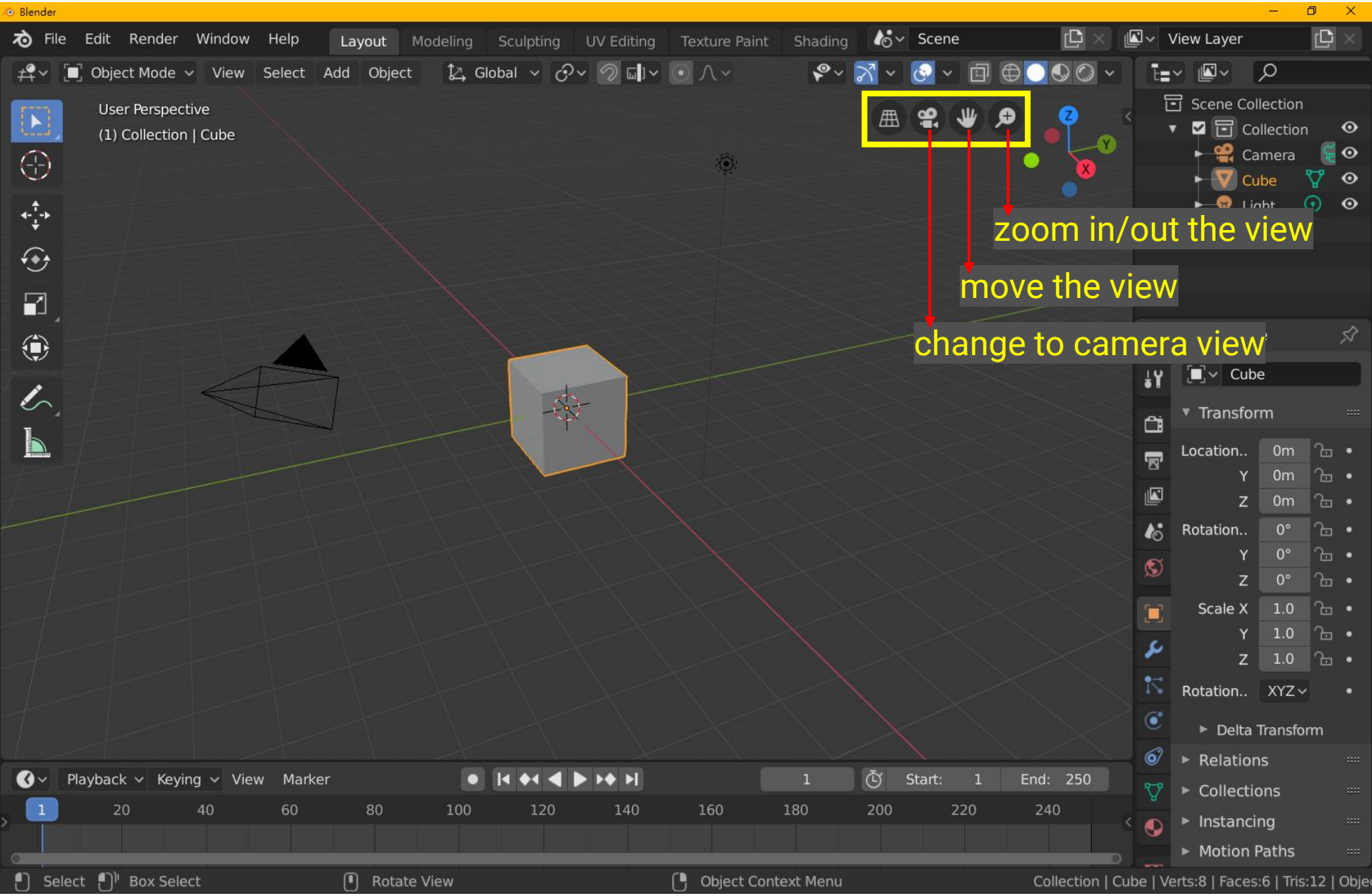


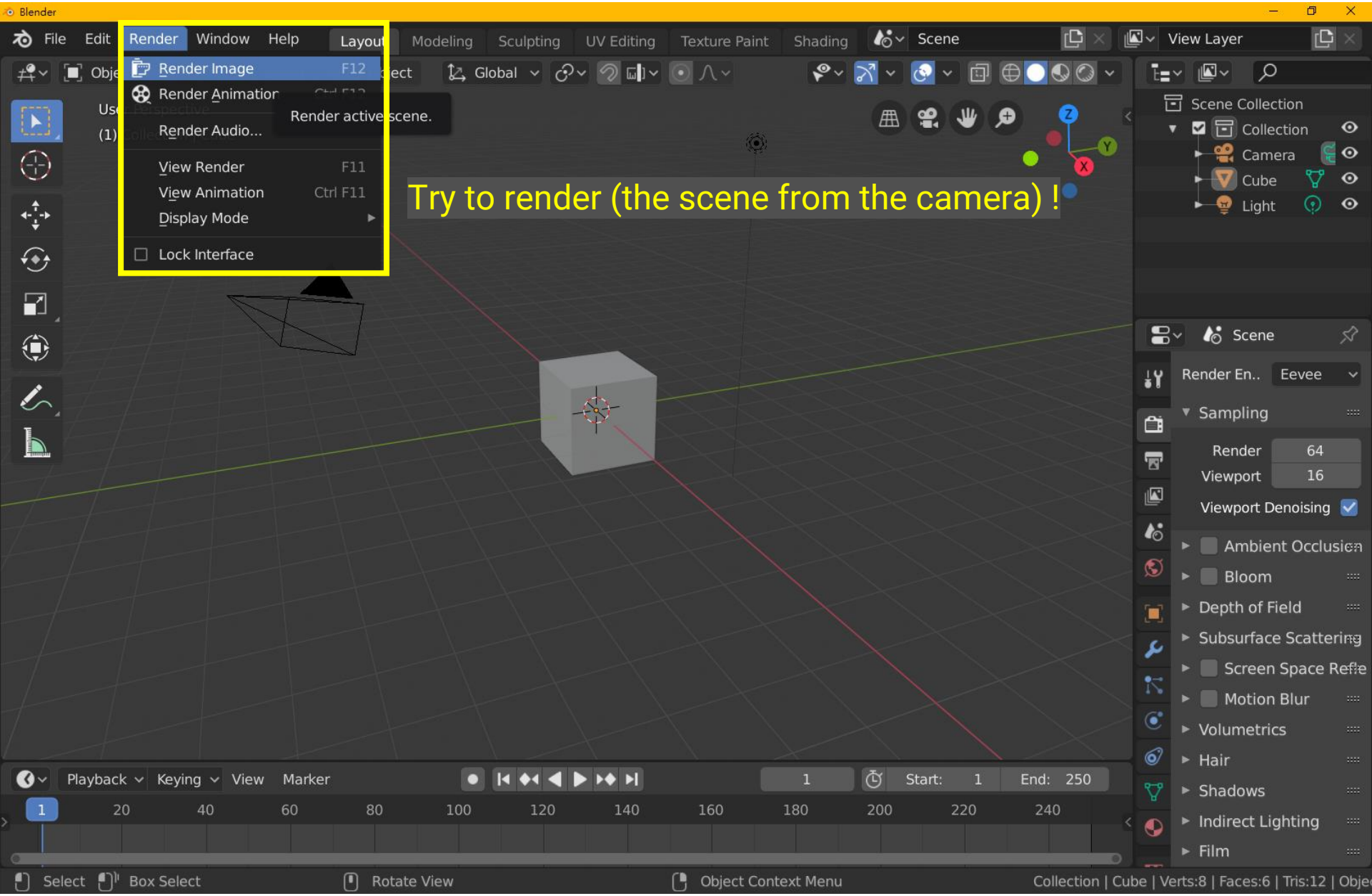


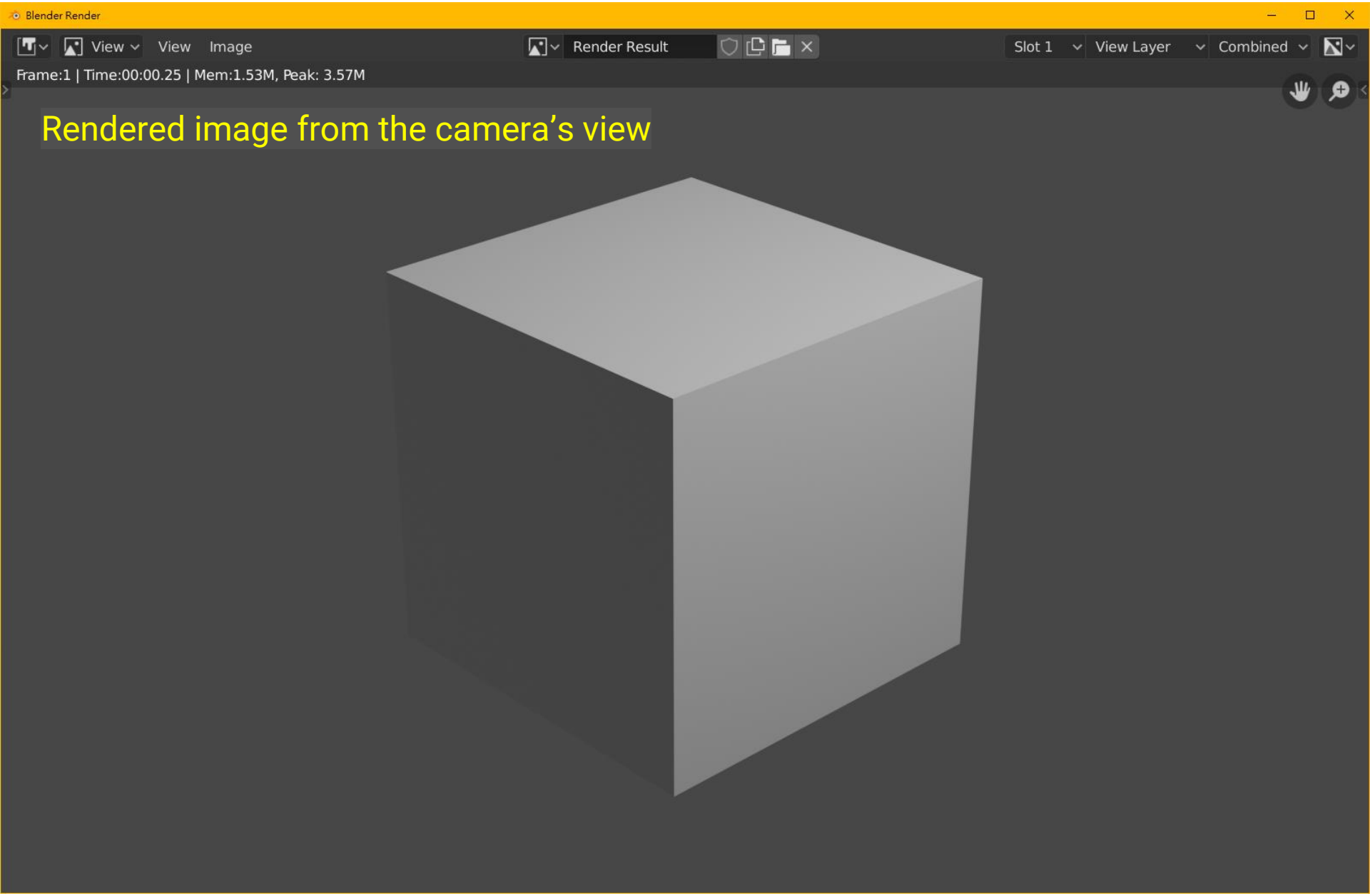


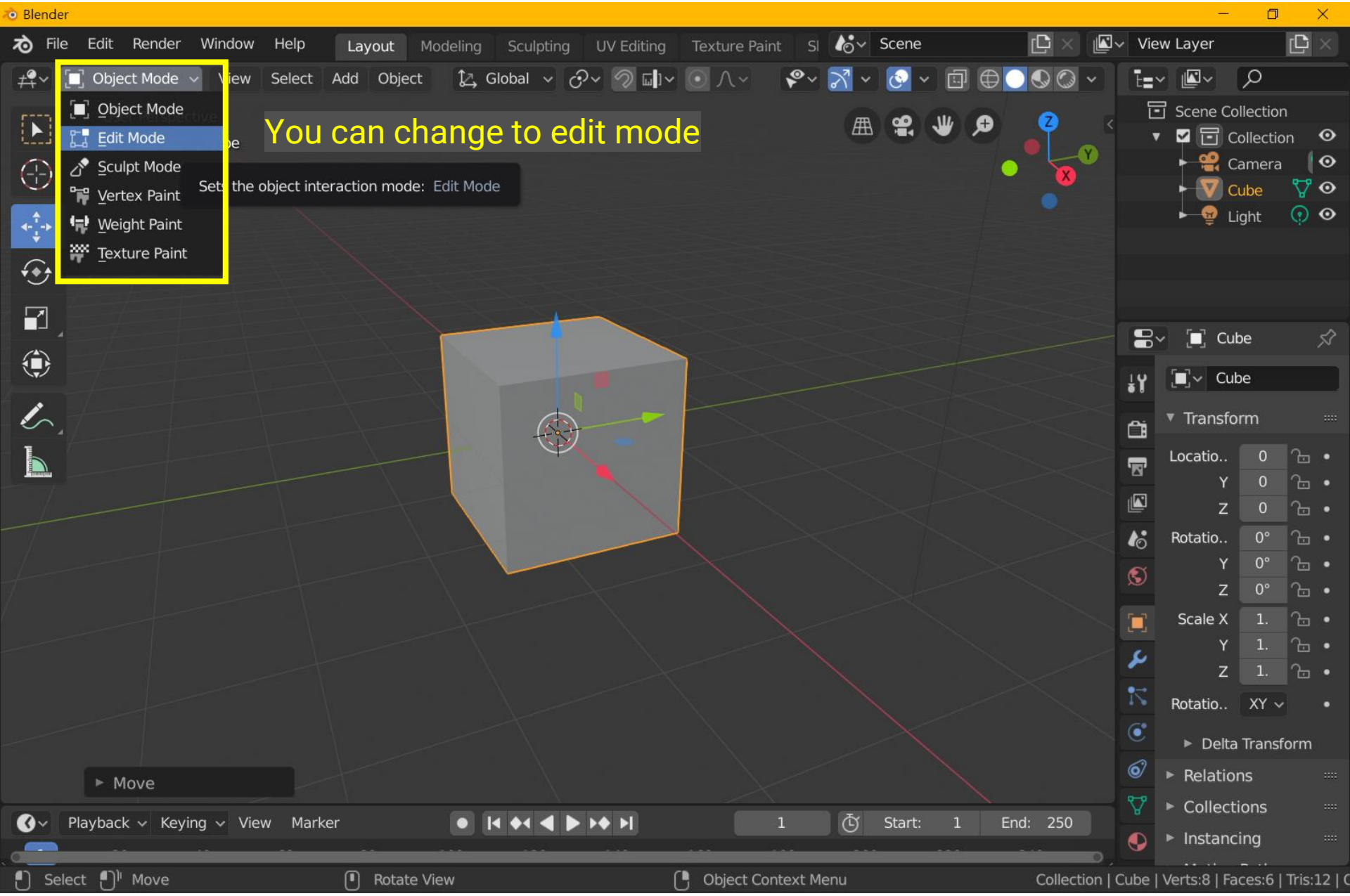
Orthogonal v.s. Perspective Projection

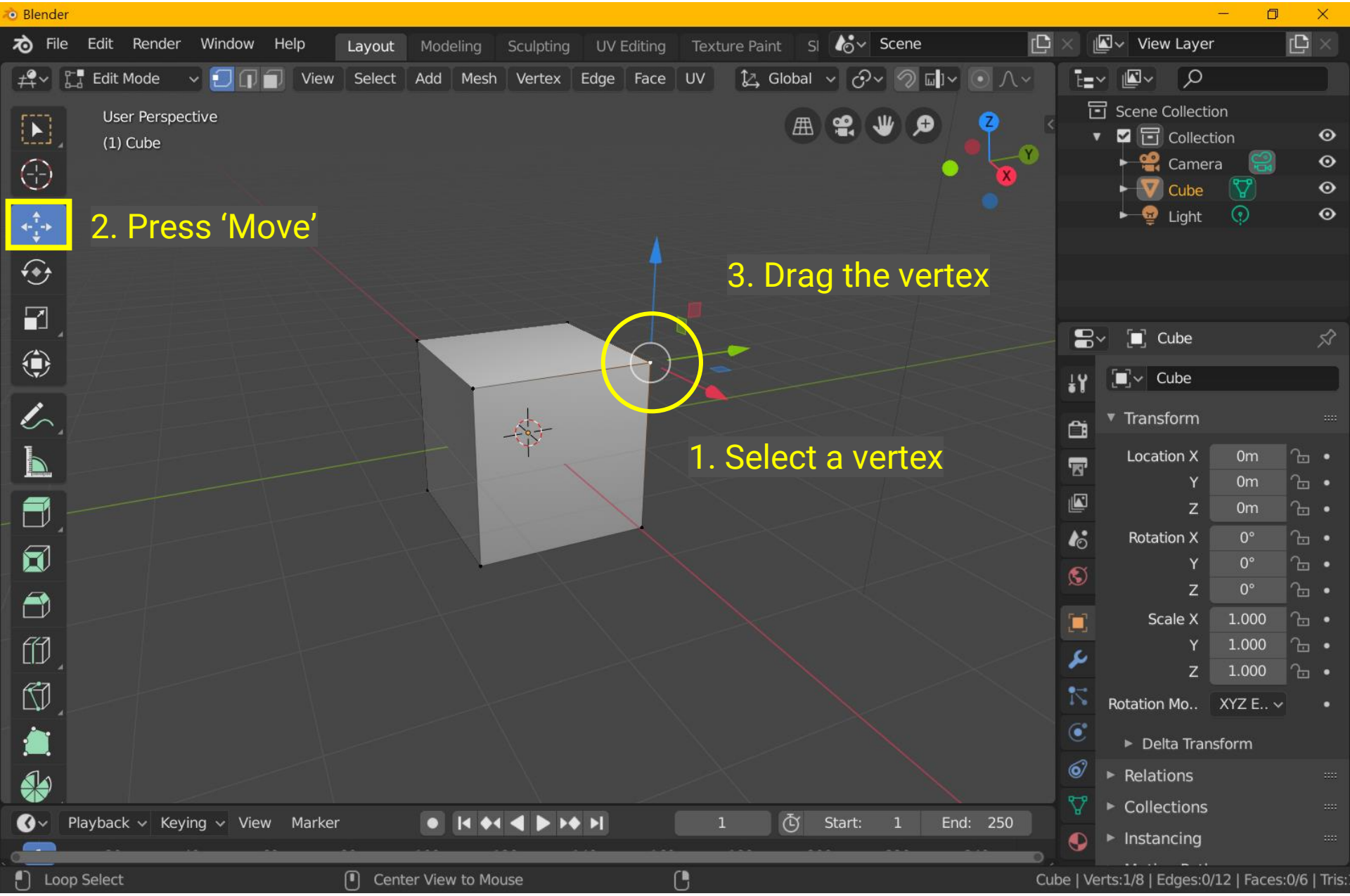



Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint Shading
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Cube
Scene Collection
Collection
Camera
Cube
Light
zoom in/out the view
move the view
change to camera view
Cube
Transform
Location.. 0m
Y 0m
Z 0m
Rotation.. 0°
Y 0°
Z 0°
Scale X 1.0
Y 1.0
Z 1.0
Rotation.. XYZ
Delta Transform
Relations
Collections
Instancing
Motion Paths
Playback Keying View Marker
1
Start: 1
End: 250
1 20 40 60 80 100 120 140 160 180 200 220 240
Select
Box Select
Rotate View
Object Context Menu
Collection | Cube | Verts:8 | Faces:6 | Tris:12

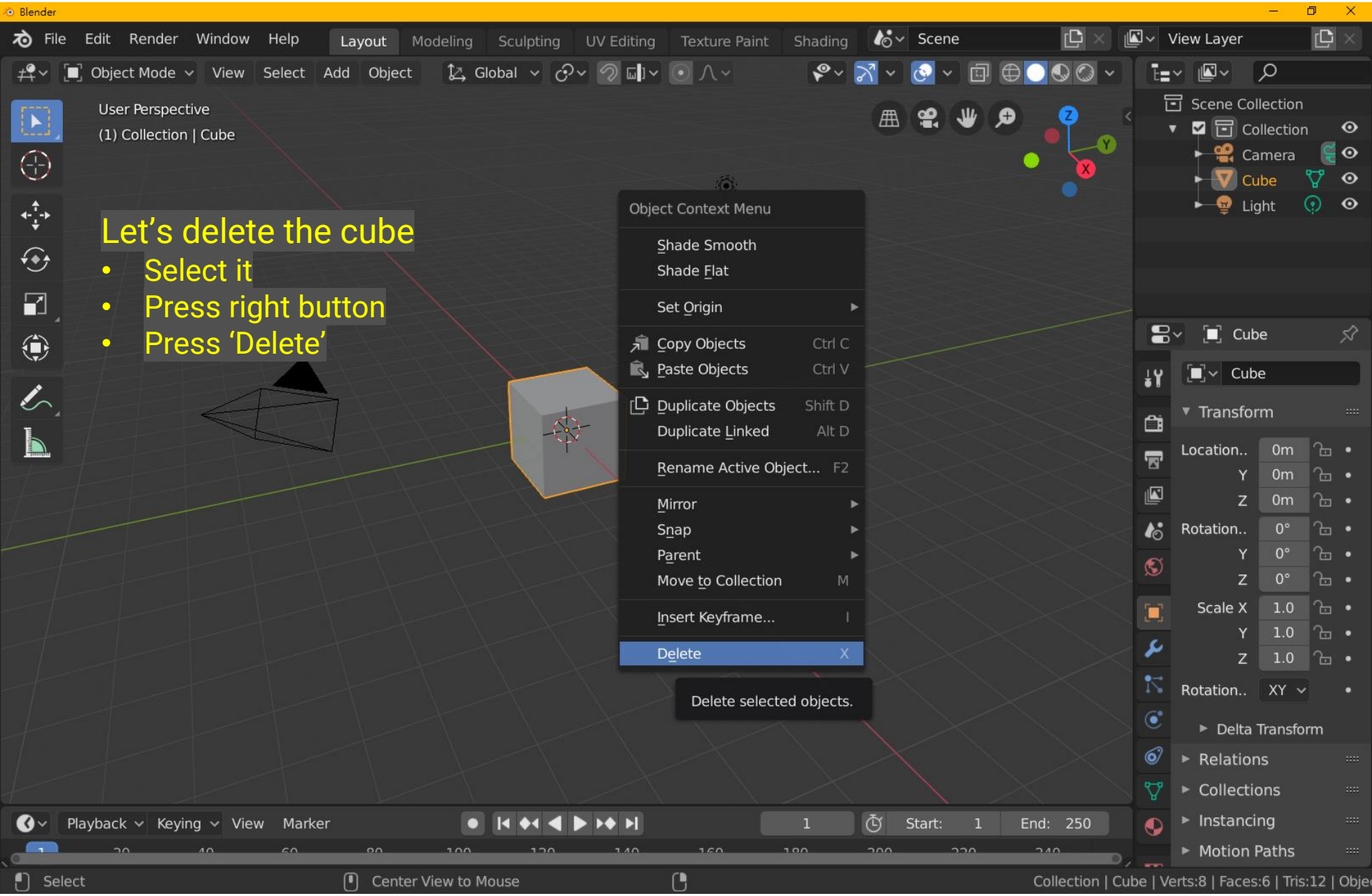

Blender
File
Edit
Render
Window
Help
Layout
Modeling
Sculpting
UV Editing
Texture Paint
Shading
Scene
View Layer
Render Image F12
Render Animation
Render Audio...
Render active scene.
View Render F11
View Animation Ctrl F11
Display Mode
Lock Interface
Try to render (the scene from the camera) !
Scene Collection
Collection
Camera
Cube
Light
Render En..
Eevee
Sampling
Render 64
Viewport 16
Viewport Denoising
Ambient Occlusion
Bloom
Depth of Field
Subsurface Scattering
Screen Space Refle
Motion Blur
Volumetrics
Hair
Shadows
Indirect Lighting
Film
Playback
Keying
View
Marker
Start: 1
End: 250
Select
Box Select
Rotate View
Object Context Menu
Collection | Cube | Verts:8 | Faces:6 | Tris:12

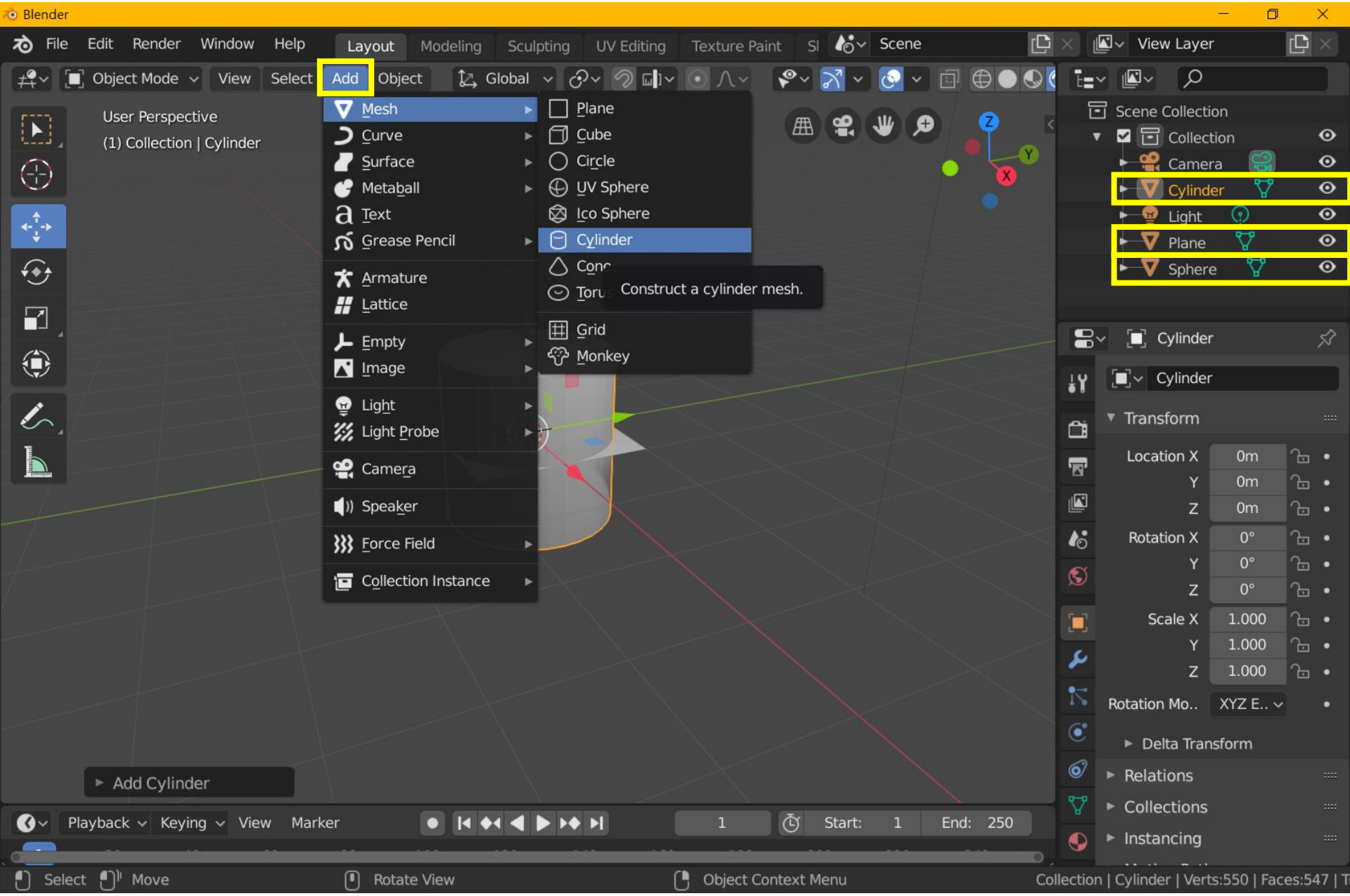

Blender Render
View
View
Image
Render Result
Slot 1
View Layer
Combined
Frame:1 | Time:00:00.25 | Mem:1.53M, Peak: 3.57M
Rendered image from the camera’s view

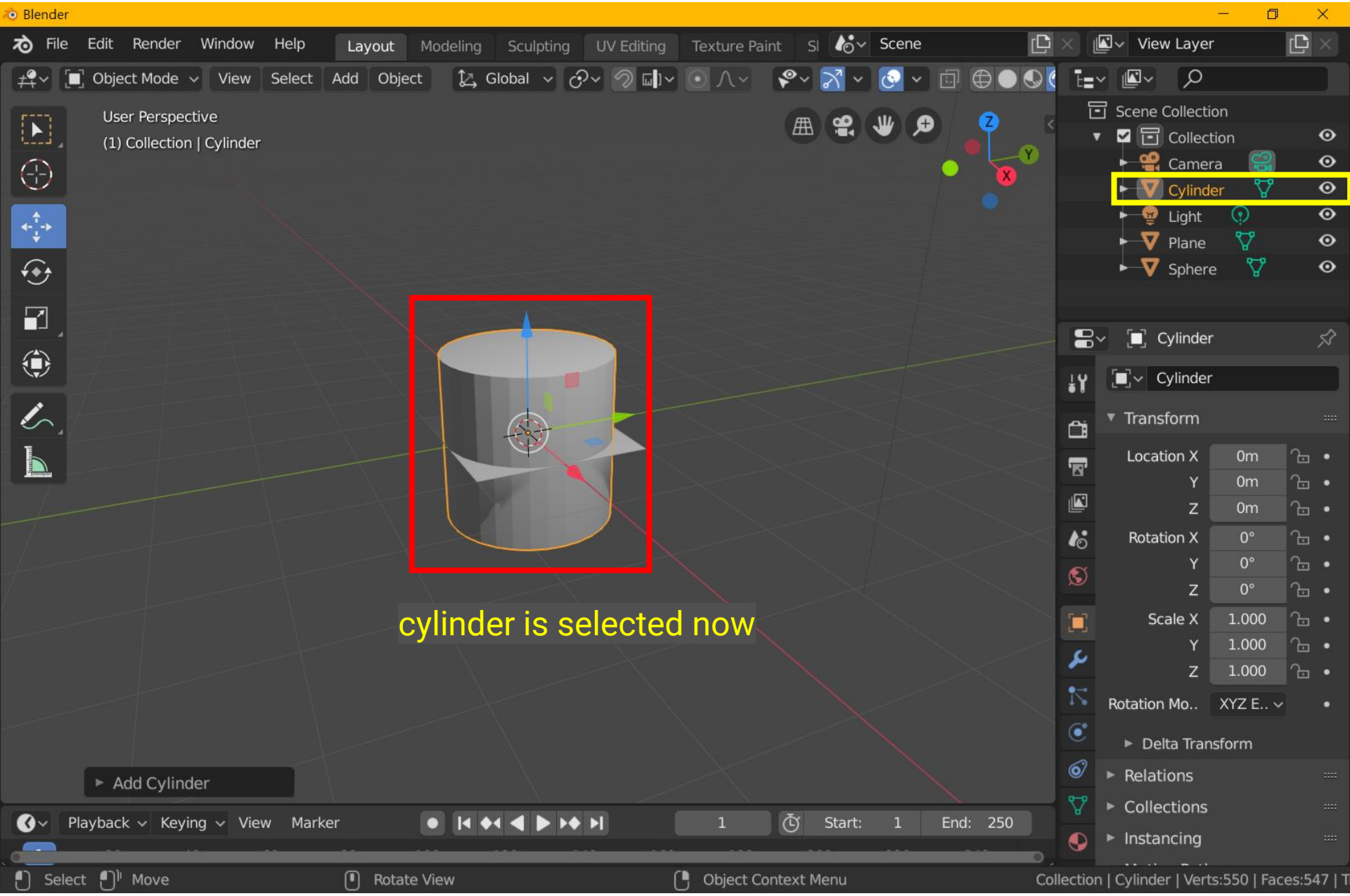

Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode
View Select Add Object
Global
Object Mode
Edit Mode
Sculpt Mode
Vertex Paint
Weight Paint
Texture Paint
You can change to edit mode
Set the object interaction mode: Edit Mode
Scene Collection
Collection
Camera
Cube
Light
Cube
Transform
Location
Rotation
Scale X
Delta Transform
Relations
Collections
Instancing
Move
Playback Keying View Marker
Start: 1
End: 250
Select
Move
Rotate View
Object Context Menu
Collection | Cube | Verts:8 | Faces:6 | Tris:12

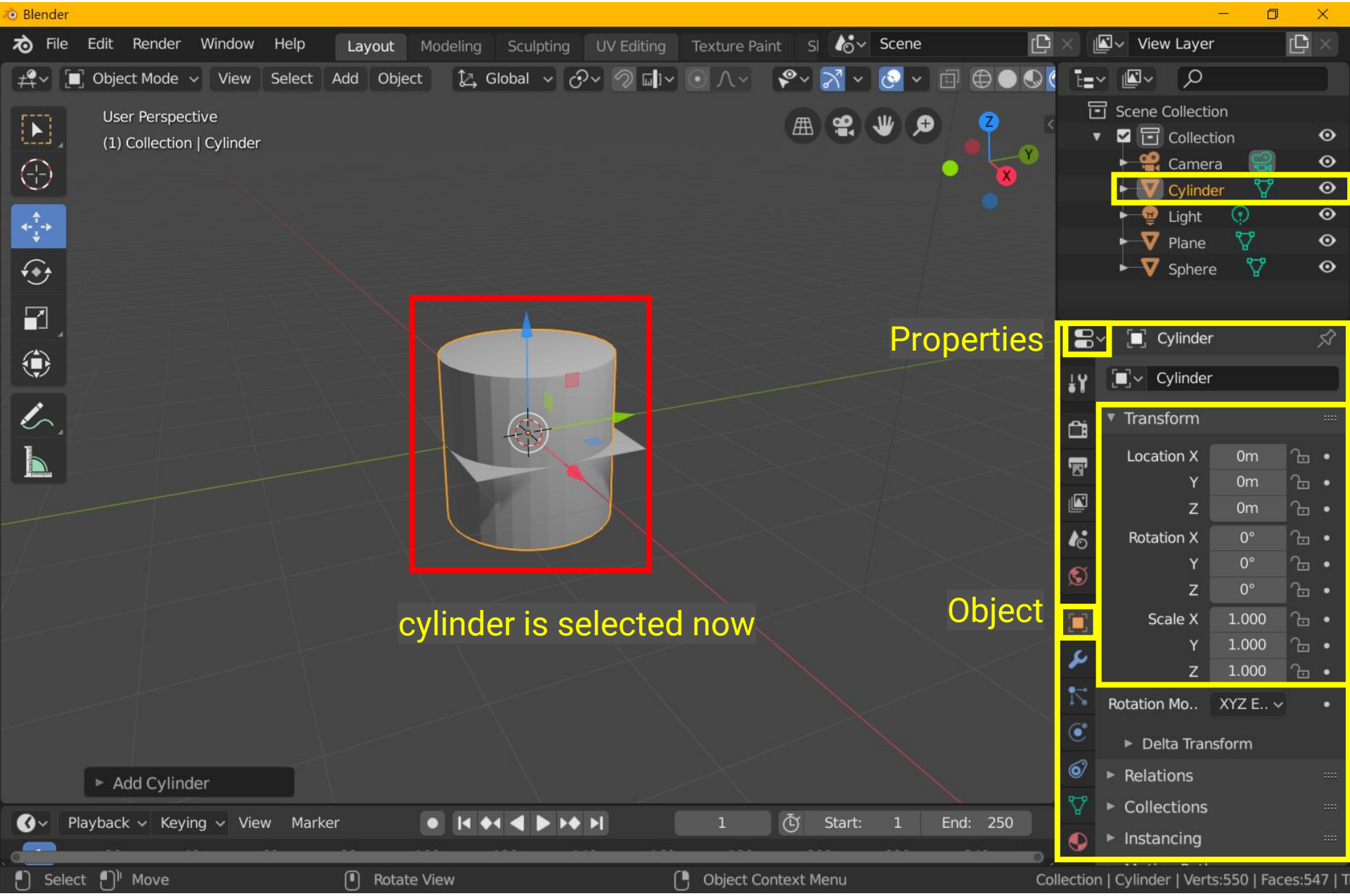

Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Edit Mode
View Select Add Mesh Vertex Edge Face UV
Global
User Perspective
(1) Cube
2. Press ‘Move’
3. Drag the vertex
1. Select a vertex
Scene Collection
Collection
Camera
Cube
Light
Transform
Location X 0m
Y 0m
Z 0m
Rotation X 0°
Y 0°
Z 0°
Scale X 1.000
Y 1.000
Z 1.000
Rotation Mo.. XYZ E..
Delta Transform
Relations
Collections
Instancing
Playback Keying View Marker
1
Start: 1
End: 250
Loop Select
Center View to Mouse
Cube | Verts:1/8 | Edges:0/12 | Faces:0/6 | Tris:

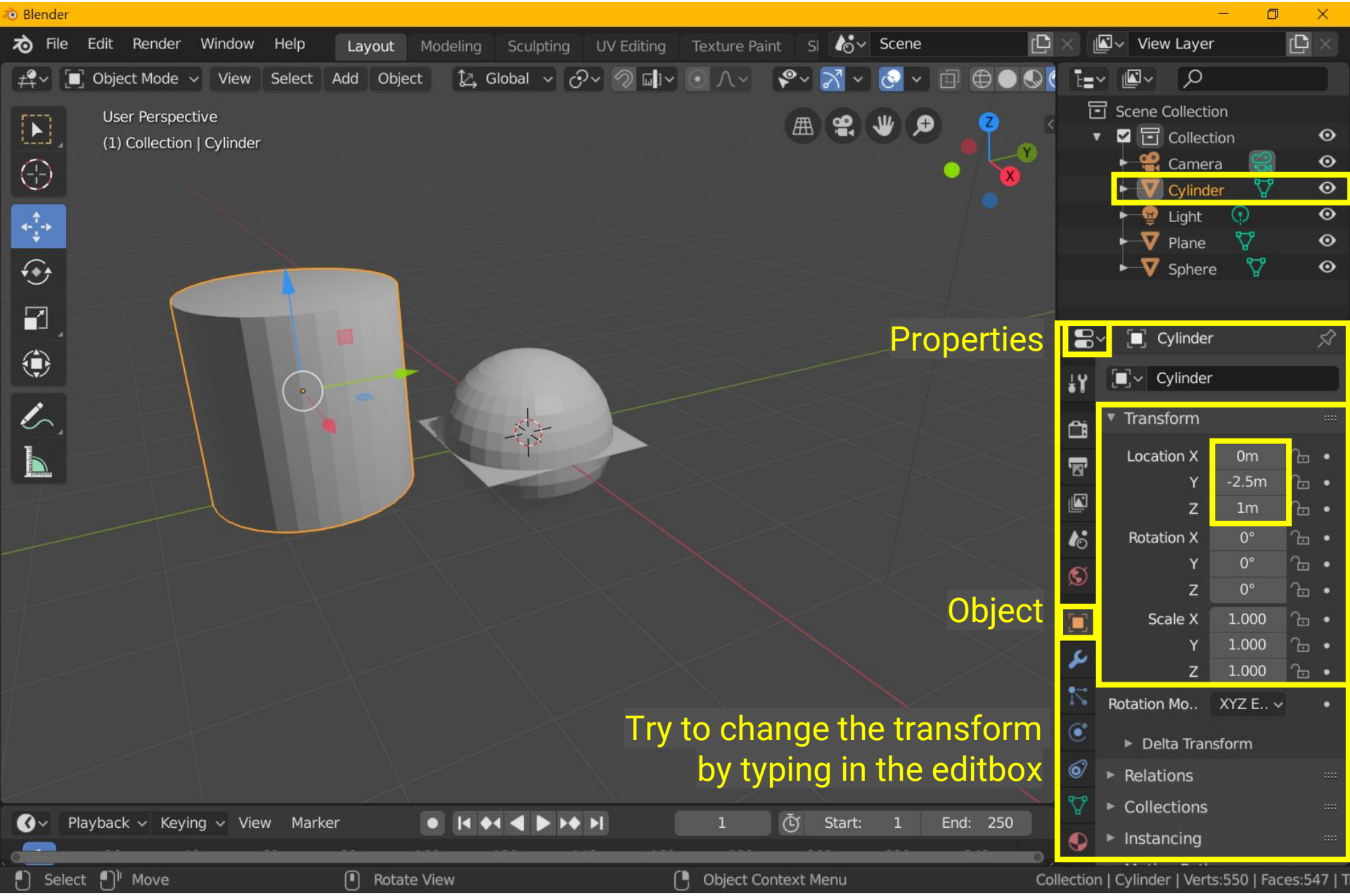
Transform

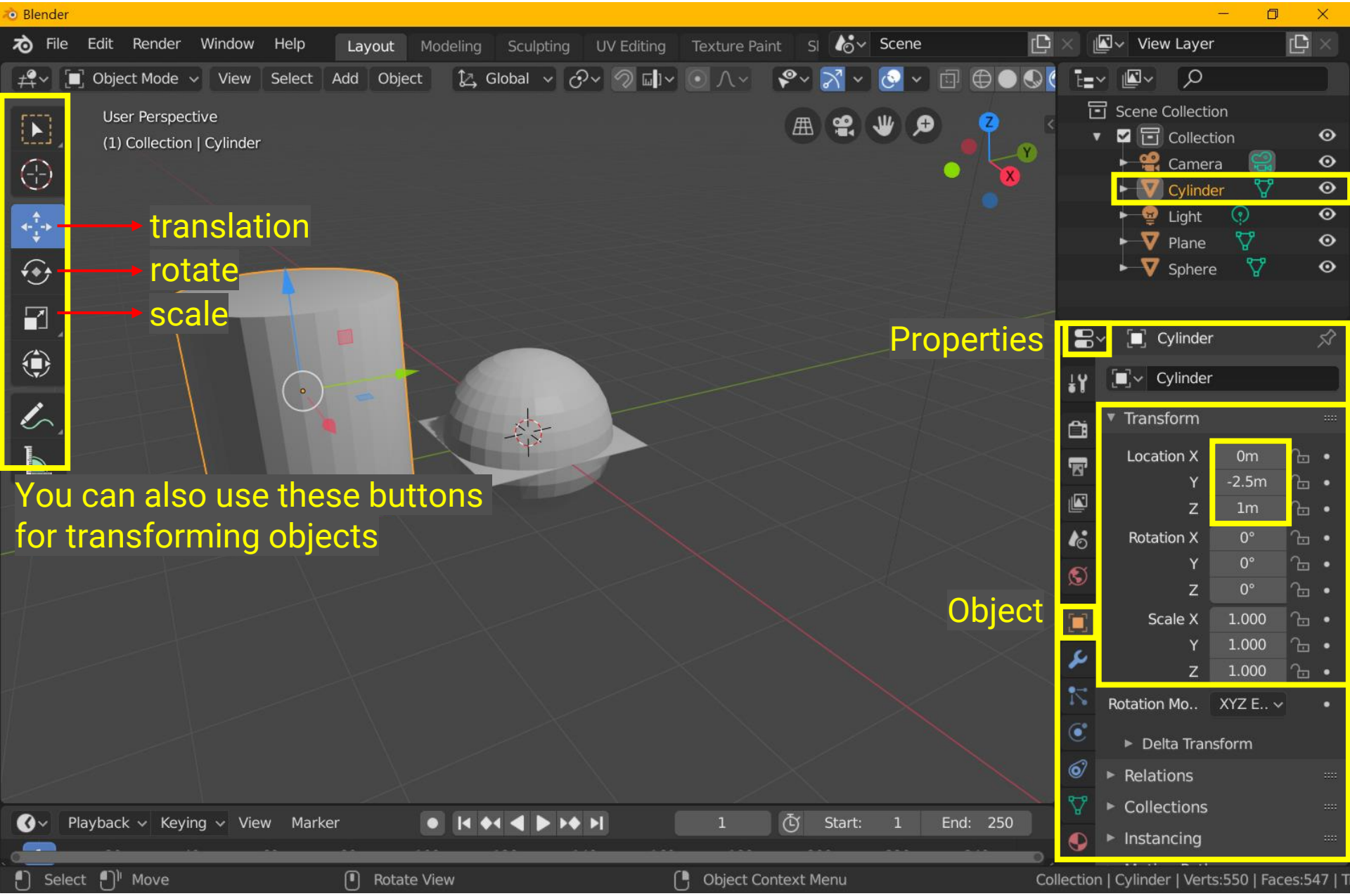

Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint Shading
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Cube
Let's delete the cube
• Select it
• Press right button
• Press 'Delete'
Object Context Menu
Shade Smooth
Shade Flat
Set Origin
Copy Objects Ctrl C
Paste Objects Ctrl V
Duplicate Objects Shift D
Duplicate Linked Alt D
Rename Active Object... F2
Mirror
Snap
Parent
Move to Collection M
Insert Keyframe... I
Delete X
Delete selected objects.
Scene Collection
Collection
Camera
Cube
Light
Cube
Cube
Transform
Location.. 0m
Y 0m
Z 0m
Rotation.. 0°
Y 0°
Z 0°
Scale X 1.0
Y 1.0
Z 1.0
Rotation.. XY
Delta Transform
Relations
Collections
Instancing
Motion Paths
Playback Keying View Marker
1
Start: 1
End: 250
Select
Center View to Mouse
Collection | Cube | Verts:8 | Faces:6 | Tris:12


Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Cylinder
Mesh
Curve
Surface
Metaball
Text
Grease Pencil
Armature
Lattice
Empty
Image
Light
Light Probe
Camera
Speaker
Force Field
Collection Instance
Plane
Cube
Circle
UV Sphere
Ico Sphere
Cylinder
Grid
Monkey
Construct a cylinder mesh.
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Cylinder
Transform
Location X 0m
Y 0m
Z 0m
Rotation X 0°
Y 0°
Z 0°
Scale X 1.000
Y 1.000
Z 1.000
Rotation Mo.. XYZ E..
Delta Transform
Relations
Collections
Instancing
Add Cylinder
Playback Keying View Marker
1
Start: 1
End: 250
Select Move
Rotate View
Object Context Menu
Collection | Cylinder | Verts:550 | Faces:547


Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Cylinder
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Cylinder
Transform
Location X 0m
Y 0m
Z 0m
Rotation X 0°
Y 0°
Z 0°
Scale X 1.000
Y 1.000
Z 1.000
Rotation Mo.. XYZ E..
Delta Transform
Relations
Collections
Instancing
cylinder is selected now
Add Cylinder
Playback Keying View Marker
1
Start: 1
End: 250
Select
Move
Rotate View
Object Context Menu
Collection | Cylinder | Verts:550 | Faces:547


Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Cylinder
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Properties
Cylinder
Transform
Location X 0m
Y 0m
Z 0m
Rotation X 0°
Y 0°
Z 0°
Scale X 1.000
Y 1.000
Z 1.000
Rotation Mo.. XYZ E..
Delta Transform
Relations
Collections
Instancing
cylinder is selected now
Object
Add Cylinder
Playback Keying View Marker
1
Start: 1
End: 250
Select
Move
Rotate View
Object Context Menu
Collection | Cylinder | Verts:550 | Faces:547

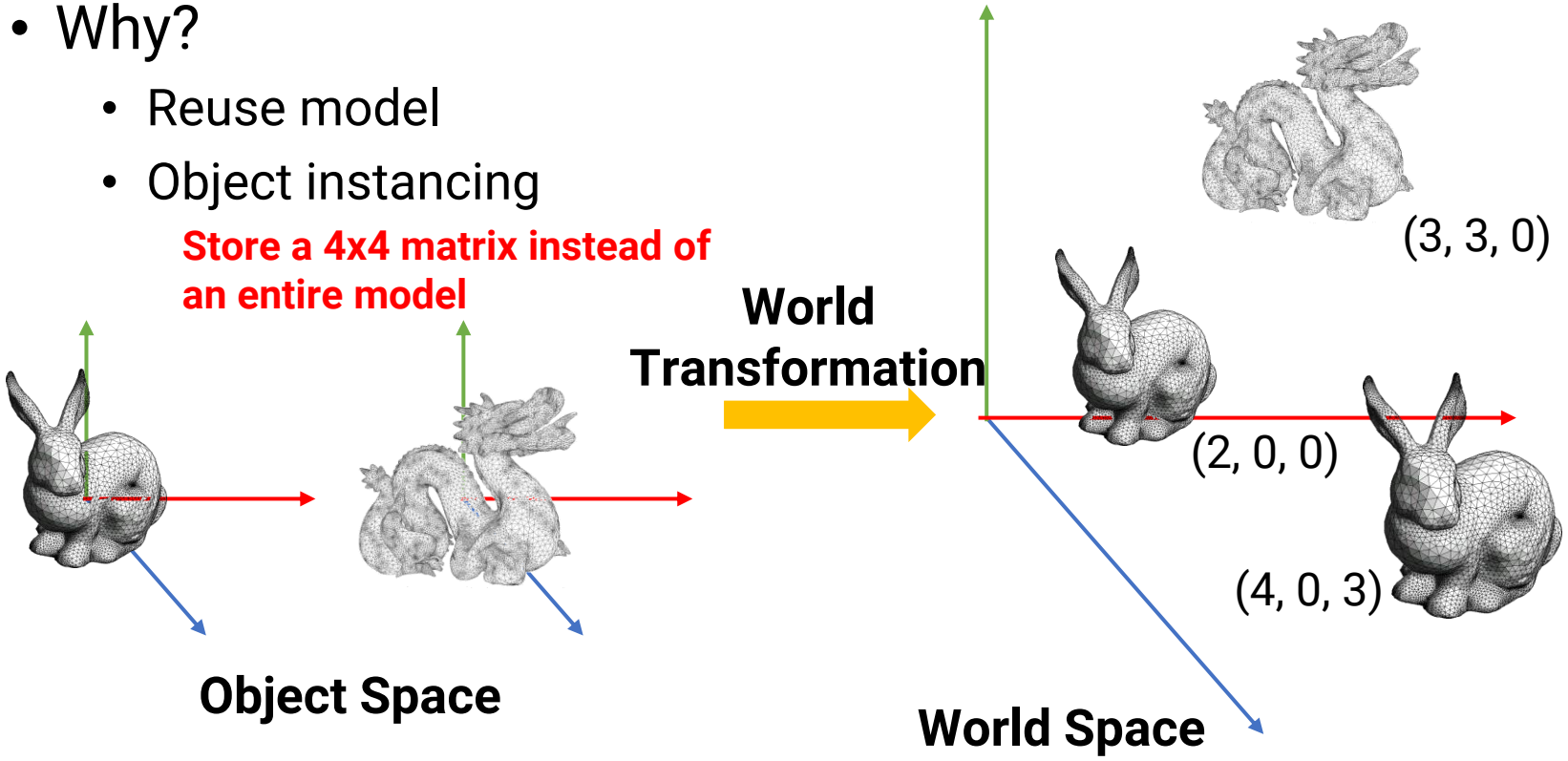

Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Cylinder
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Properties
Cylinder
Transform
Location X 0m
Y -2.5m
Z 1m
Rotation X 0°
Y 0°
Z 0°
Scale X 1.000
Y 1.000
Z 1.000
Rotation Mo.. XYZ E..
Delta Transform
Relations
Collections
Instancing
Object
Try to change the transform
by typing in the editbox
Playback Keying View Marker
1
Start: 1
End: 250
Select Move
Rotate View
Object Context Menu
Collection | Cylinder | Verts:550 | Faces:547

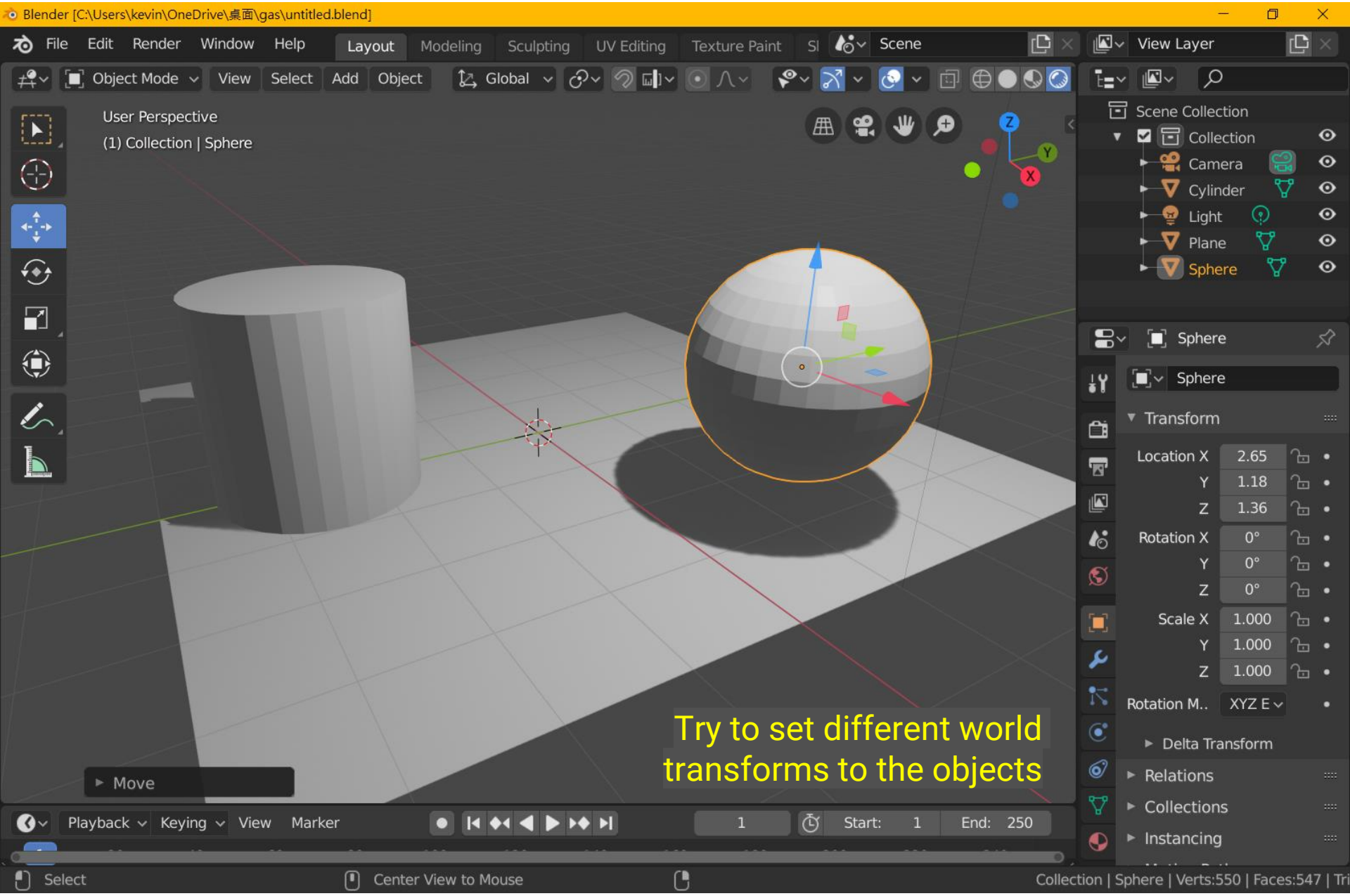

Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Cylinder
translation
rotate
scale
You can also use these buttons for transforming objects
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Properties
Cylinder
Transform
Location X 0m
Y -2.5m
Z 1m
Rotation X 0°
Y 0°
Z 0°
Scale X 1.000
Y 1.000
Z 1.000
Rotation Mo.. XYZ E..
Delta Transform
Relations
Collections
Instancing
Object
Playback Keying View Marker
1
Start: 1
End: 250
Select Move
Rotate View
Object Context Menu
Collection | Cylinder | Verts:550 | Faces:547

Recap: Object Space and World Space

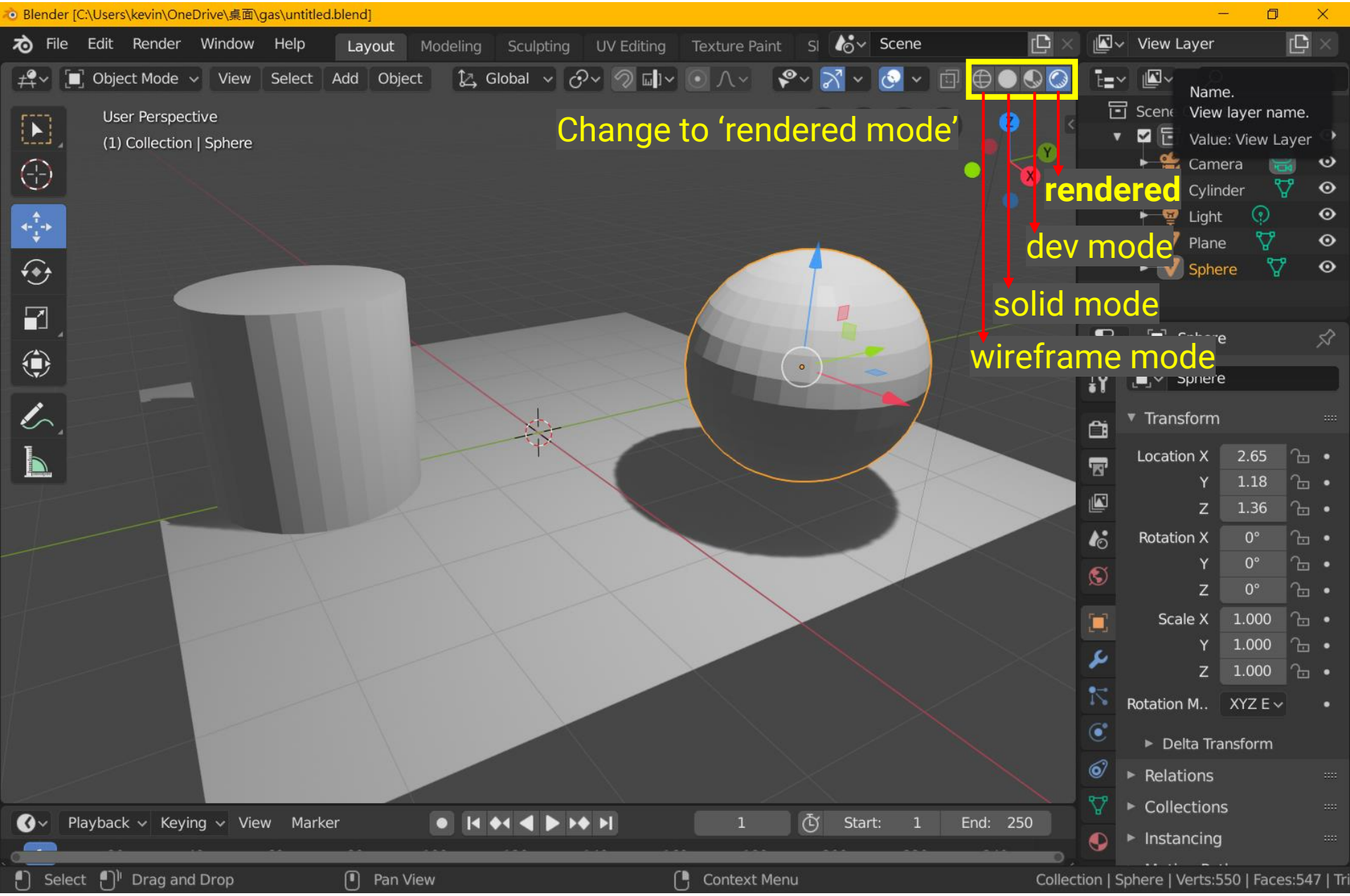
- Shapes (or objects) are defined in **object space** and transformed to **world space**
- Why?
  - Reuse model
  - Object instancing

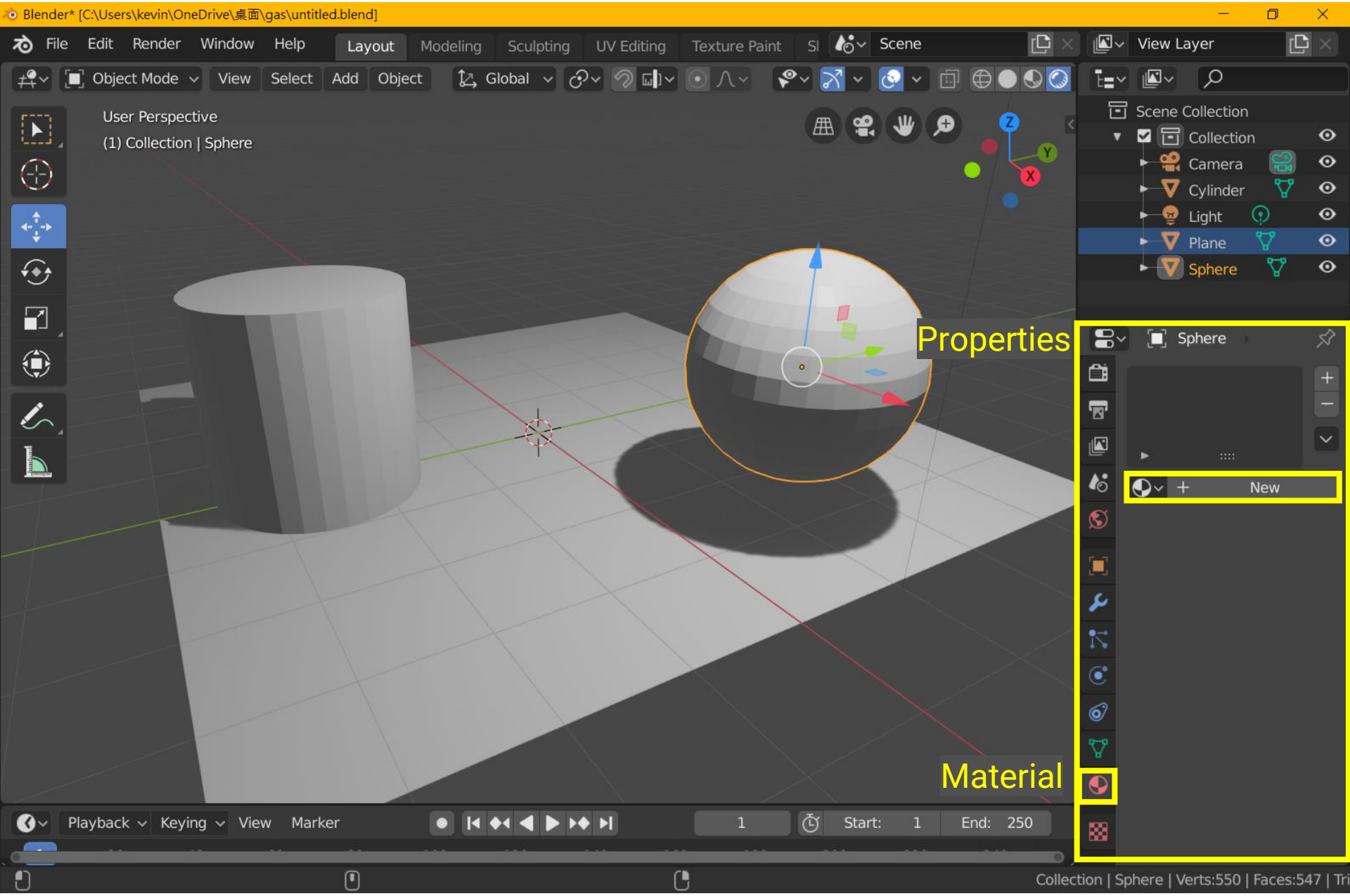
Store a 4x4 matrix instead of an entire model

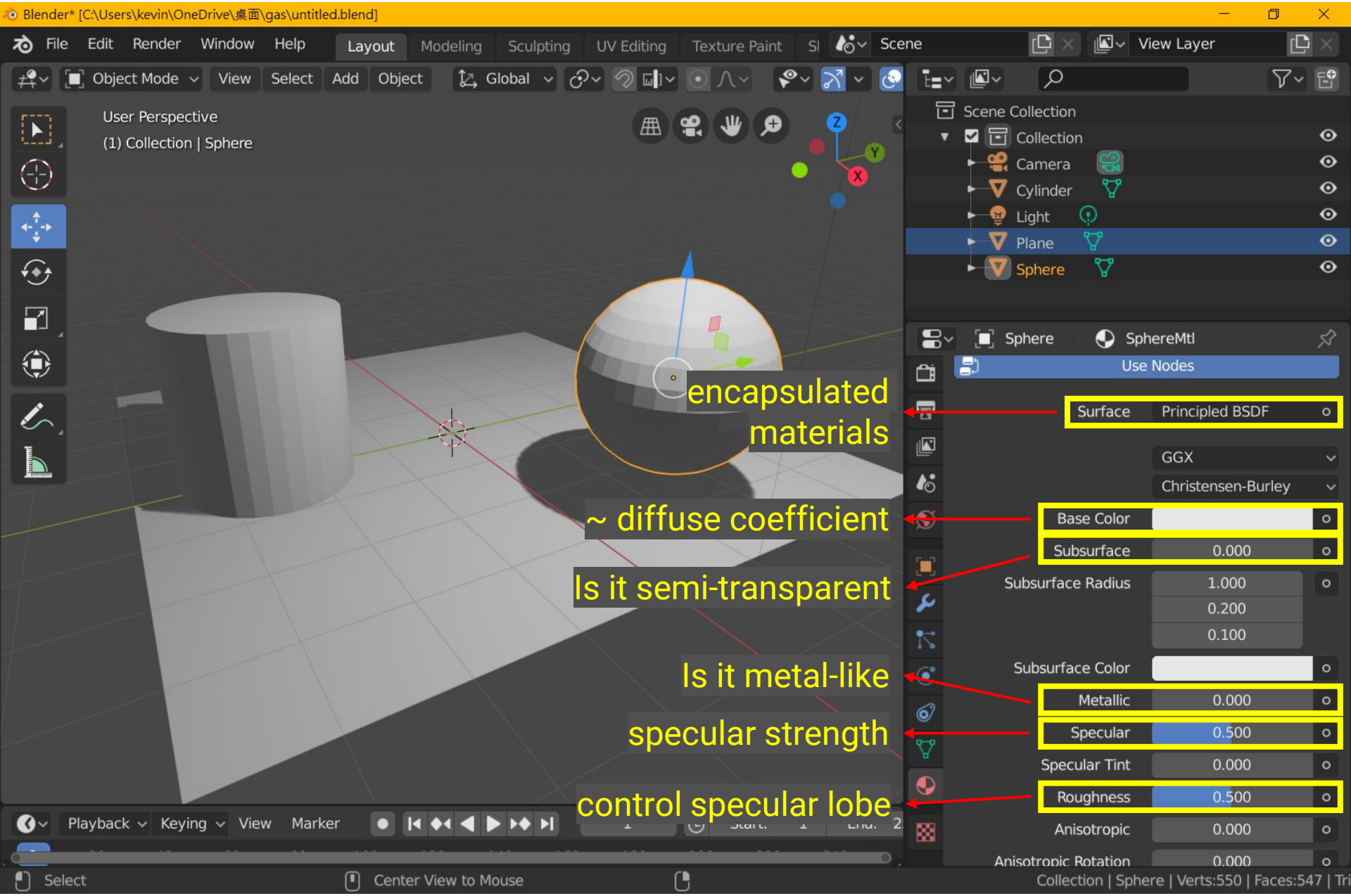



Blender [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Sphere
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Transform
Location X 2.65
Y 1.18
Z 1.36
Rotation X 0°
Y 0°
Z 0°
Scale X 1.000
Y 1.000
Z 1.000
Rotation M.. XYZ E
Delta Transform
Relations
Collections
Instancing
Try to set different world transforms to the objects
Move
Playback Keying View Marker
Start: 1
End: 250
Select
Center View to Mouse
Collection | Sphere | Verts:550 | Faces:547

Materials

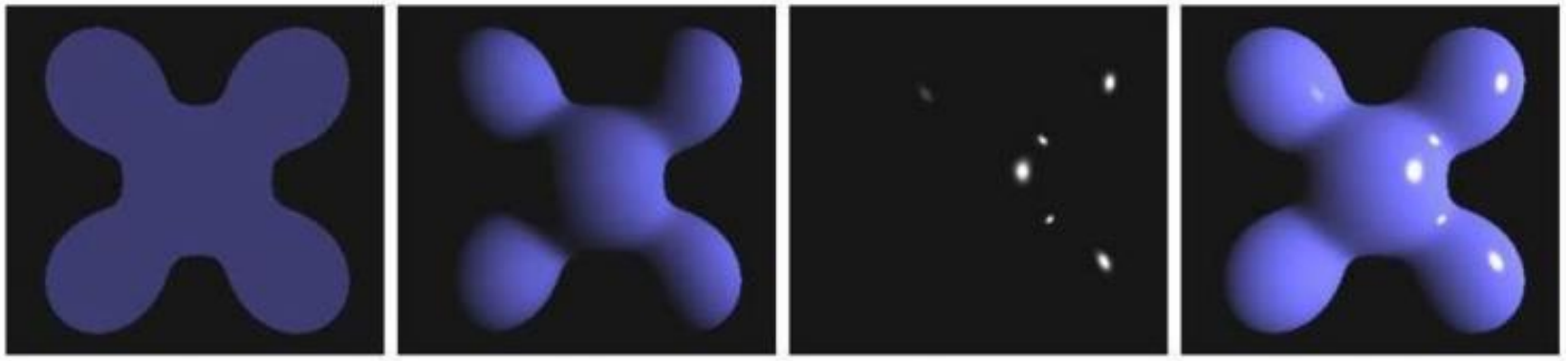

Blender [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Sphere
Change to 'rendered mode'
rendered
dev mode
solid mode
wireframe mode
Name.
View layer name.
Value: View Layer
Camera
Cylinder
Light
Plane
Sphere
Transform
Location X 2.65
Y 1.18
Z 1.36
Rotation X 0°
Y 0°
Z 0°
Scale X 1.000
Y 1.000
Z 1.000
Rotation M.. XYZ E
Delta Transform
Relations
Collections
Instancing
Playback Keying View Marker
1
Start: 1
End: 250
Select
Drag and Drop
Pan View
Context Menu
Collection | Sphere | Verts:550 | Faces:547


Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Sphere
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Properties
Sphere
New
Material
Playback Keying View Marker
1
Start: 1
End: 250
Collection | Sphere | Verts:550 | Faces:547


Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Sphere
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere SphereMtl
Use Nodes
Surface Principled BSDF
GGX
Christensen-Burley
Base Color
Subsurface 0.000
Subsurface Radius 1.000 0.200 0.100
Subsurface Color
Metallic 0.000
Specular 0.500
Specular Tint 0.000
Roughness 0.500
Anisotropic 0.000
Anisotropic Rotation 0.000
encapsulated materials
~ diffuse coefficient
Is it semi-transparent
Is it metal-like
specular strength
control specular lobe
Playback Keying View Marker
Select
Center View to Mouse
Collection | Sphere | Verts:550 | Faces:547

Recap: Basics of Local Shading

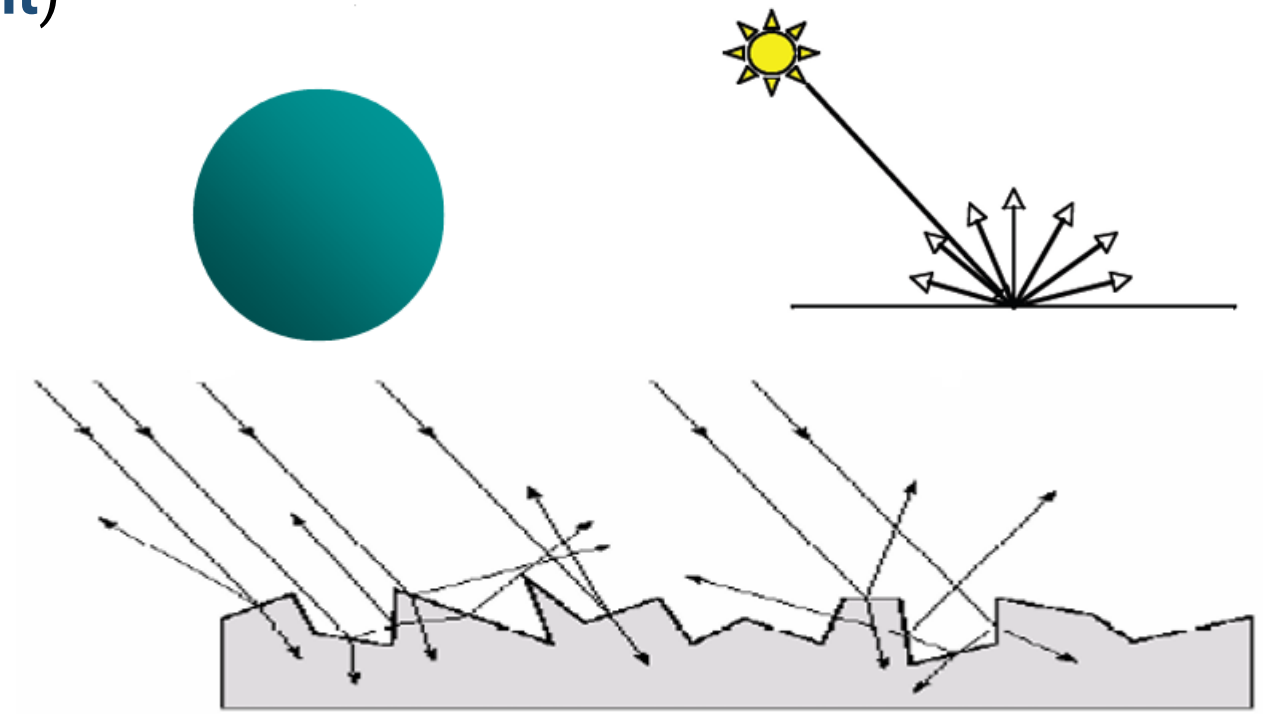
- **Diffuse reflection**
  - Light goes everywhere; colored by object color
- **Specular reflection**
  - Happens only near mirror configuration; usually white
- **Ambient reflection**
  - Constant accounted for other source of illumination



ambient diffuse specular

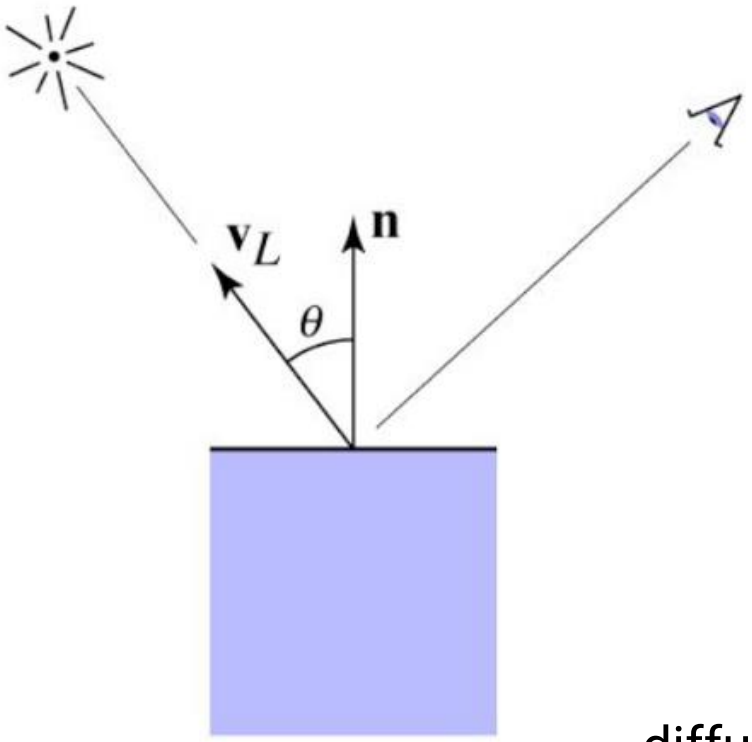
Recap: Diffuse Shading

- Assume light reflects **equally in all directions**
  - The surface is rough with lots of tiny microfacets
- Therefore, surface looks same color from all views (**view independent**)



Recap: Diffuse Shading (cont.)

- Applies to diffuse, Lambertian or matte surface



illumination from source

$$L_d = k_d \, I \, \max(0, n \cdot V_L)$$

diffuse coefficient

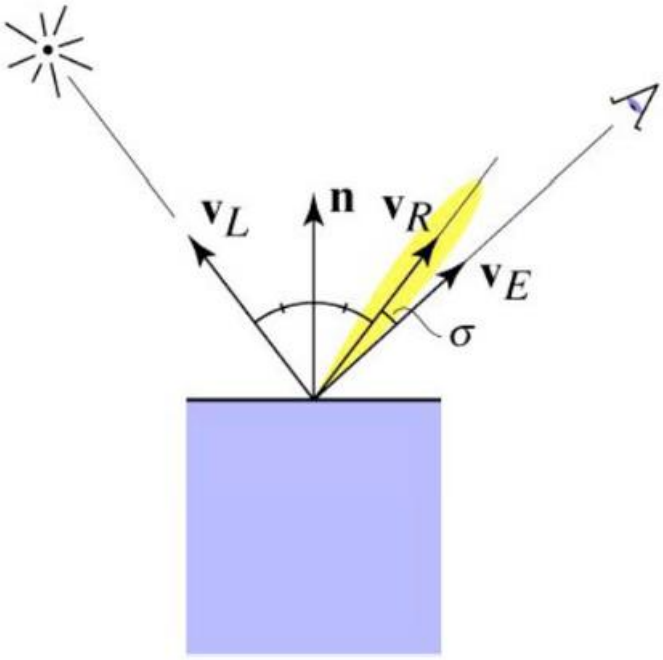
diffusely reflected light

Recap: Specular Shading

- Some surfaces have highlights, mirror-like reflection
- **View direction dependent**
- Especially obvious for smooth shinny surfaces

Recap: Specular Shading (cont.)

- Also known as glossy
- Phong specular model [1975]
  - Fall off gradually from the perfect reflection direction



$$V_R = V_L + 2((\mathbf{n} \cdot V_L)\,\mathbf{n} - V_L)$$
$$= 2(\mathbf{n} \cdot V_L)\,\mathbf{n} - V_L$$

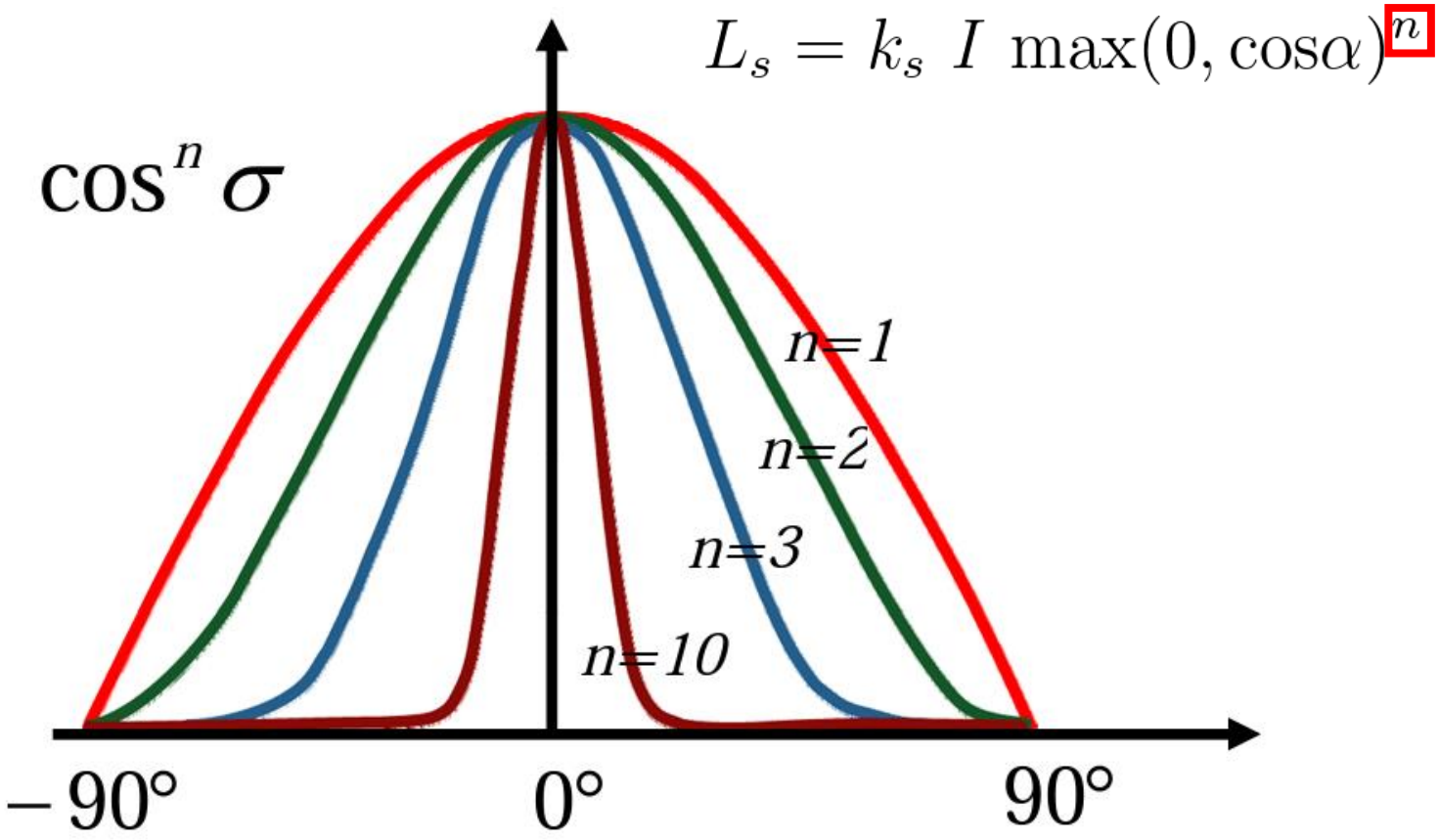
$$L_s = k_s\ I\ \max(0, \cos\sigma)^n$$
$$= k_s\ I\ \max(0, V_E \cdot V_R)^n$$

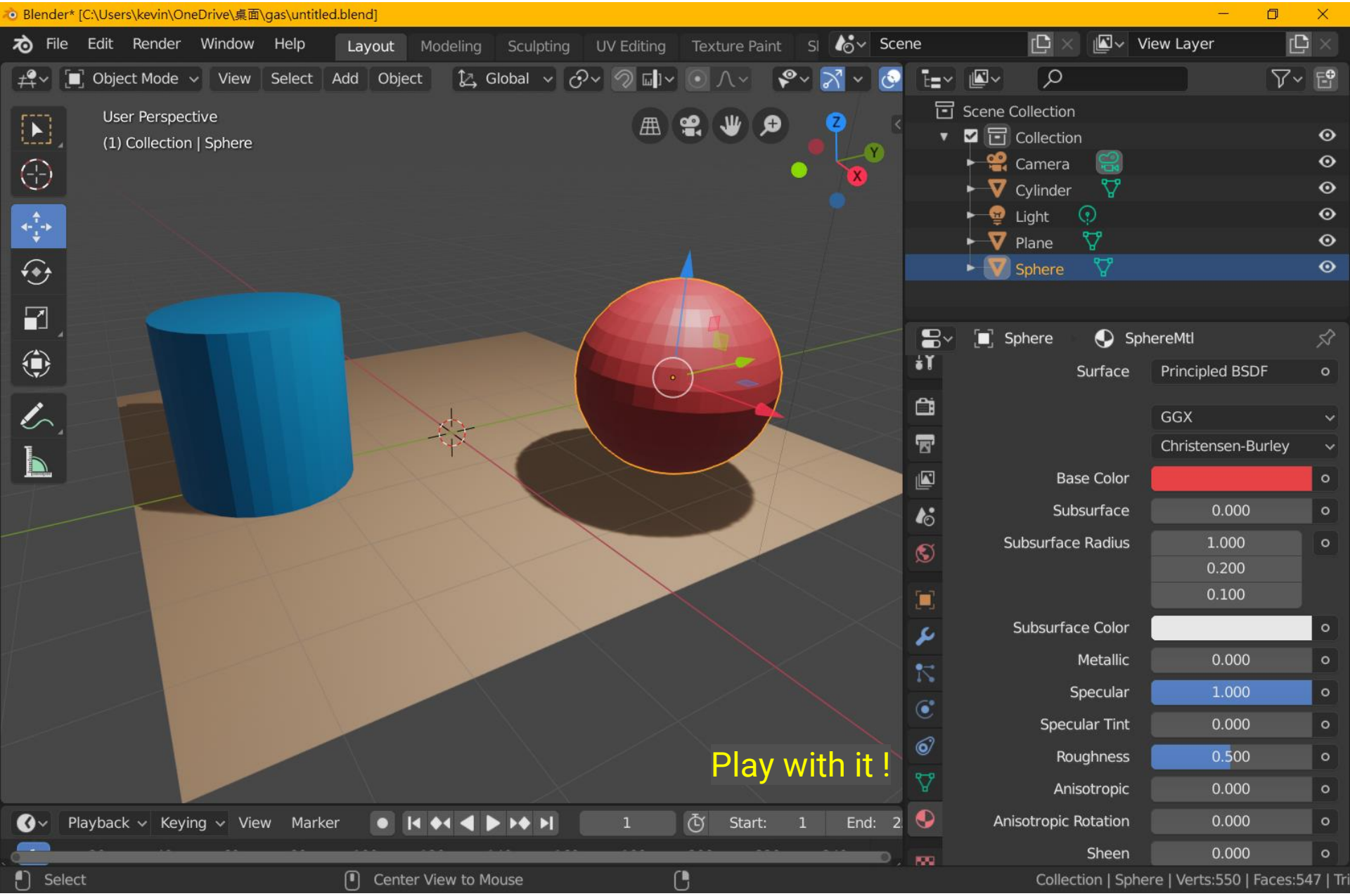
specular coefficient

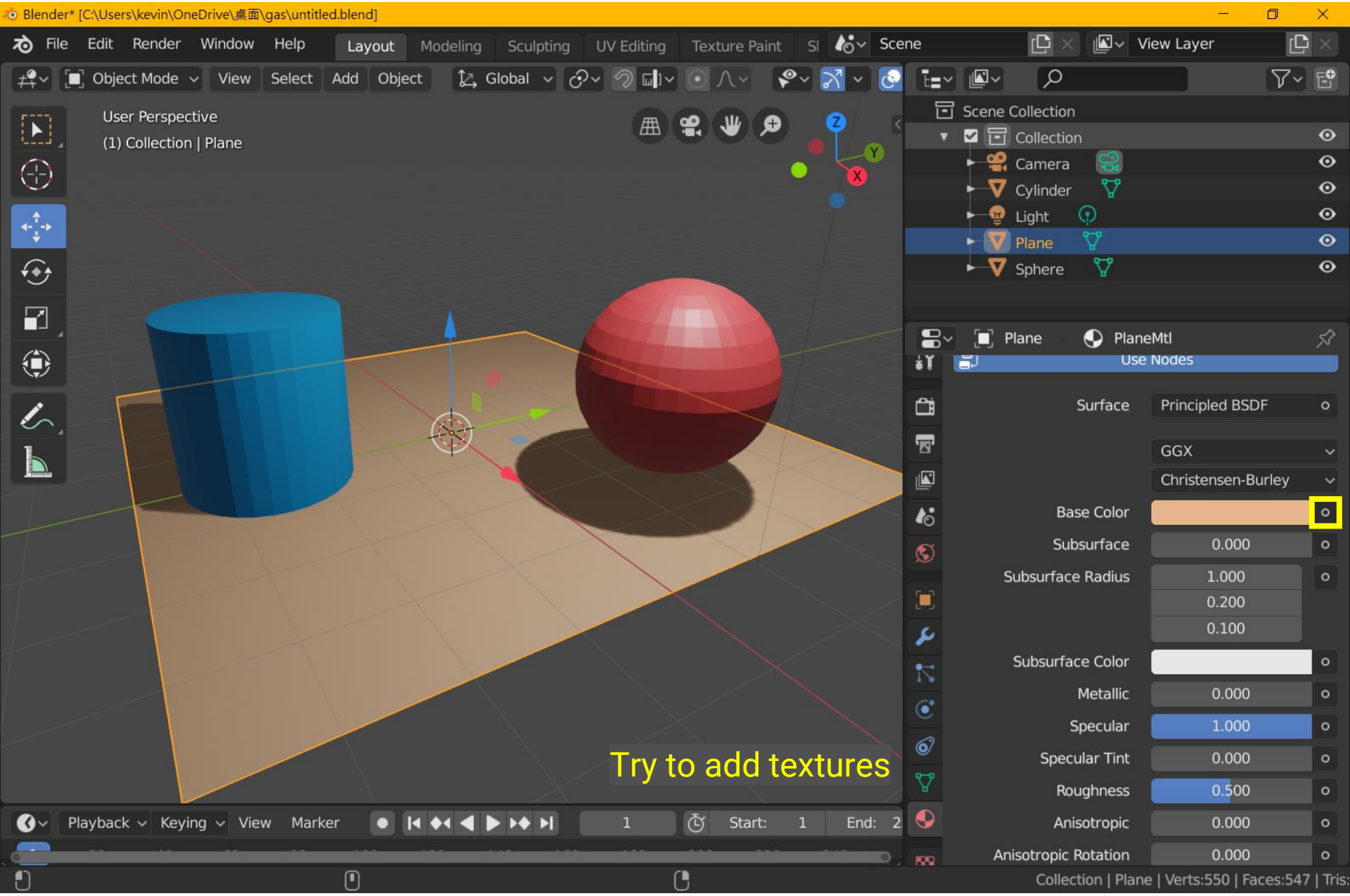
specularly reflected light

Recap: Specular Shading (cont.)

- Increase n narrows the lobe




Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Sphere
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere SphereMtl
Surface Principled BSDF
GGX
Christensen-Burley
Base Color
Subsurface 0.000
Subsurface Radius 1.000 0.200 0.100
Subsurface Color
Metallic 0.000
Specular 1.000
Specular Tint 0.000
Roughness 0.500
Anisotropic 0.000
Anisotropic Rotation 0.000
Sheen 0.000
Play with it !
Playback Keying View Marker
Start: 1 End: 2
Select
Center View to Mouse
Collection | Sphere | Verts:550 | Faces:547


Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
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(1) Collection | Plane
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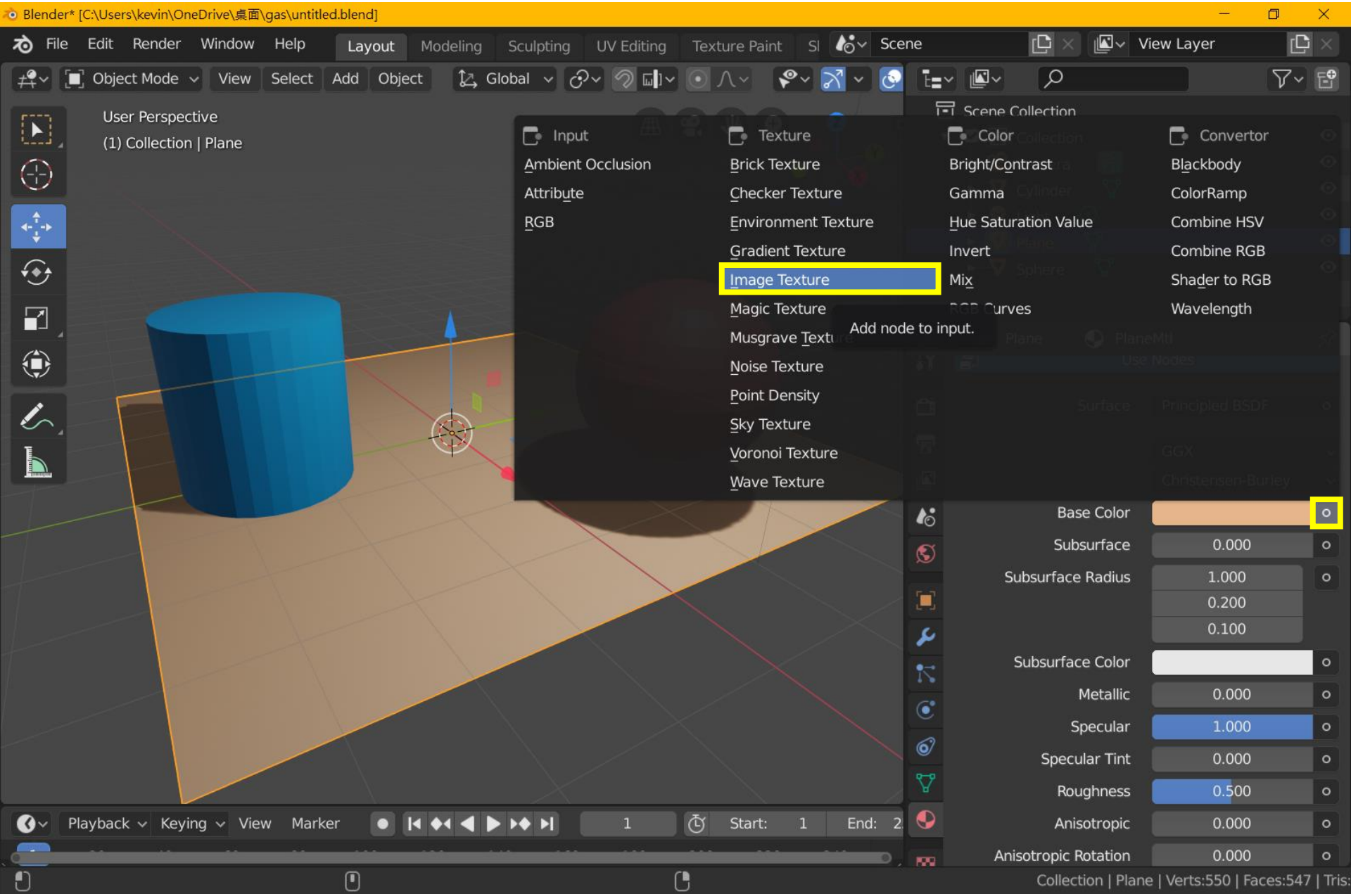
Camera
Cylinder
Light
Plane
Sphere
Plane
PlaneMtl
Use Nodes
Surface
Principled BSDF
GGX
Christensen-Burley
Base Color
Subsurface
0.000
Subsurface Radius
1.000
0.200
0.100
Subsurface Color
Metallic
0.000
Specular
1.000
Specular Tint
0.000
Roughness
0.500
Anisotropic
0.000
Anisotropic Rotation
0.000
Try to add textures
Playback Keying View Marker
1
Start: 1
End: 2
Collection | Plane | Verts:550 | Faces:547 | Tris:


Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
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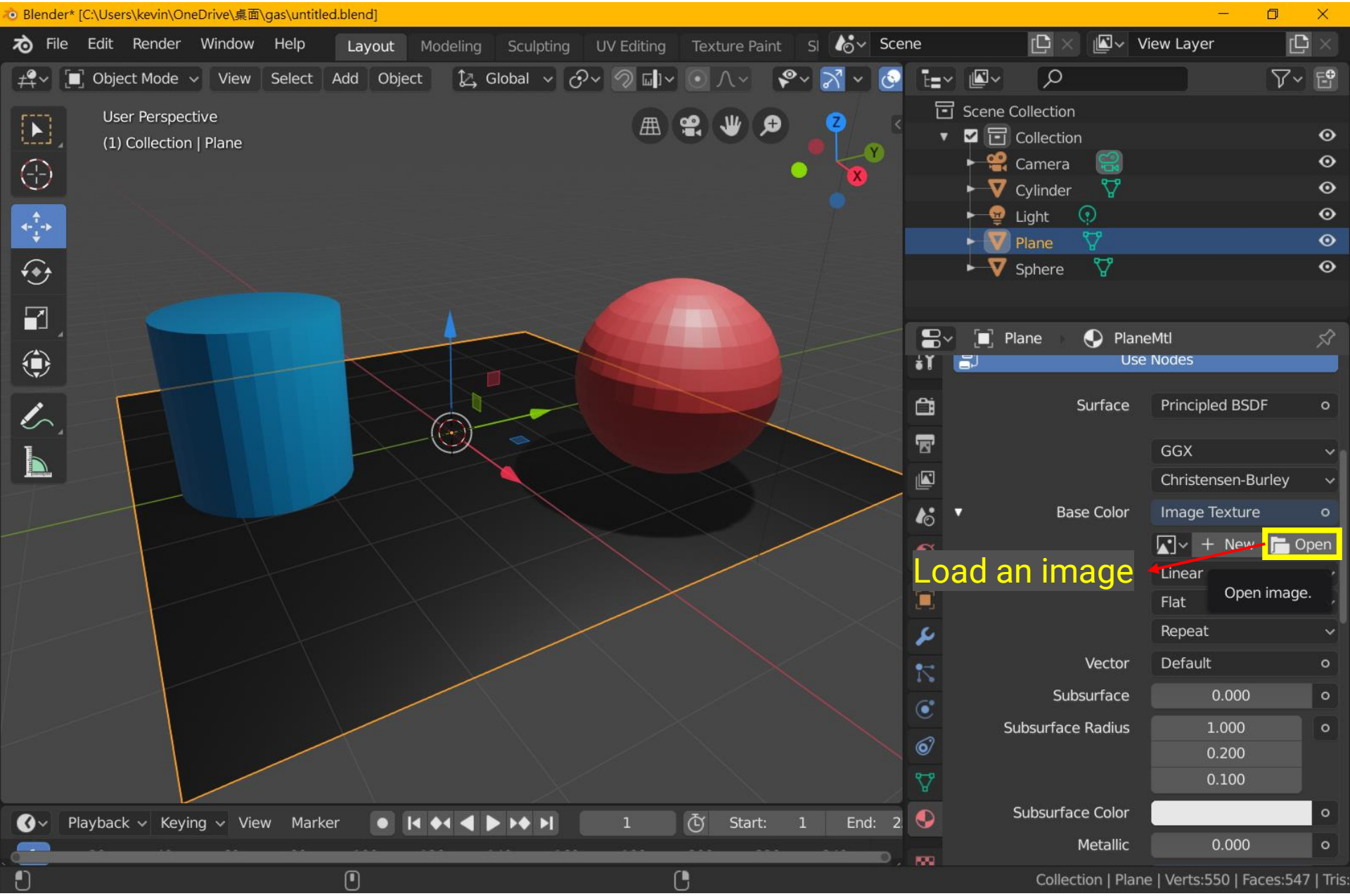
Global
User Perspective
(1) Collection | Plane
Input
Ambient Occlusion
Attribute
RGB
Texture
Brick Texture
Checker Texture
Environment Texture
Gradient Texture
Image Texture
Magic Texture
Musgrave Texture
Noise Texture
Point Density
Sky Texture
Voronoi Texture
Wave Texture
Color
Bright/Contrast
Gamma
Hue Saturation Value
Invert
Mix
RGB Curves
Convertor
Blackbody
ColorRamp
Combine HSV
Combine RGB
Shader to RGB
Wavelength
Add node to input.
Scene Collection
Base Color
Subsurface 0.000
Subsurface Radius 1.000 0.200 0.100
Subsurface Color
Metallic 0.000
Specular 1.000
Specular Tint 0.000
Roughness 0.500
Anisotropic 0.000
Anisotropic Rotation 0.000
Playback Keying View Marker
Start: 1 End: 2
Collection | Plane | Verts:550 | Faces:547 | Tris:


Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
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View Layer
Object Mode View Select Add Object
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User Perspective
(1) Collection | Plane
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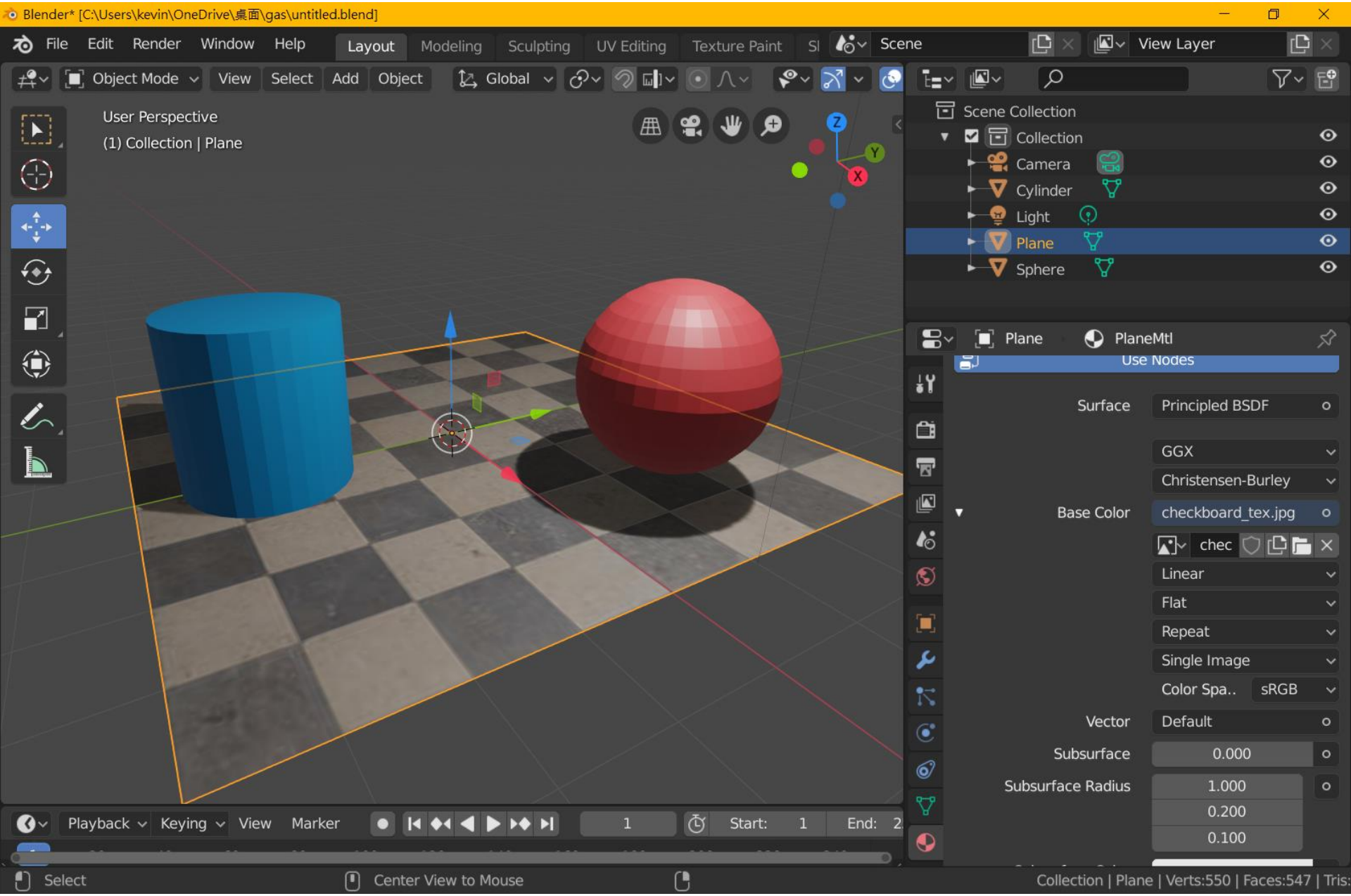
Camera
Cylinder
Light
Plane
Sphere
Plane PlaneMtl
Use Nodes
Surface Principled BSDF
GGX
Christensen-Burley
Base Color Image Texture
New Open
Load an image
Open image.
Linear
Flat
Repeat
Vector Default
Subsurface 0.000
Subsurface Radius 1.000 0.200 0.100
Subsurface Color
Metallic 0.000
Playback Keying View Marker
Start: 1 End: 2
Collection | Plane | Verts:550 | Faces:547 | Tris:


Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Plane
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Plane
PlaneMtl
Use Nodes
Surface
Principled BSDF
GGX
Christensen-Burley
Base Color
checkboard_tex.jpg
Linear
Flat
Repeat
Single Image
Color Spa..
sRGB
Vector
Default
Subsurface
0.000
Subsurface Radius
1.000
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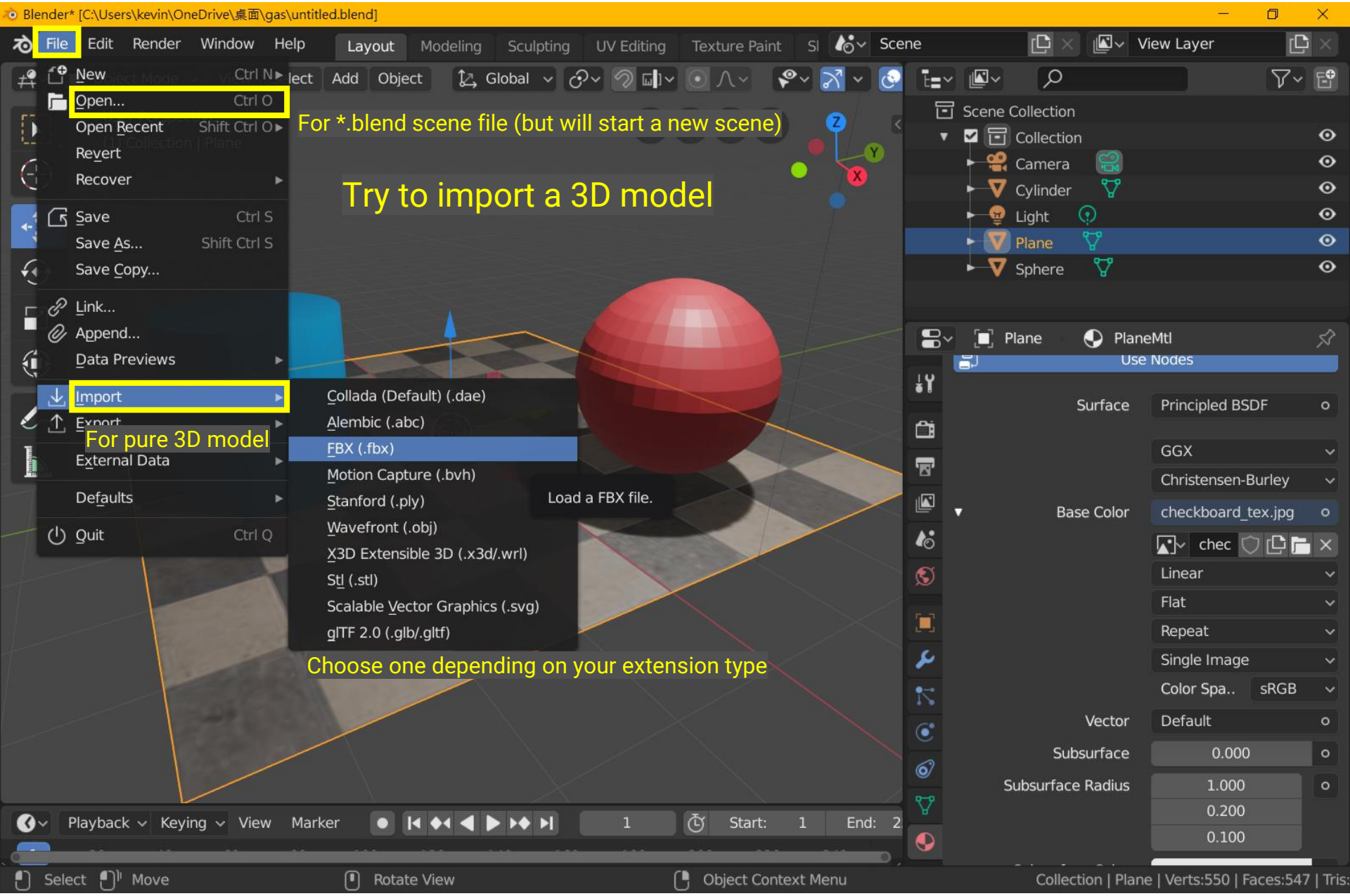
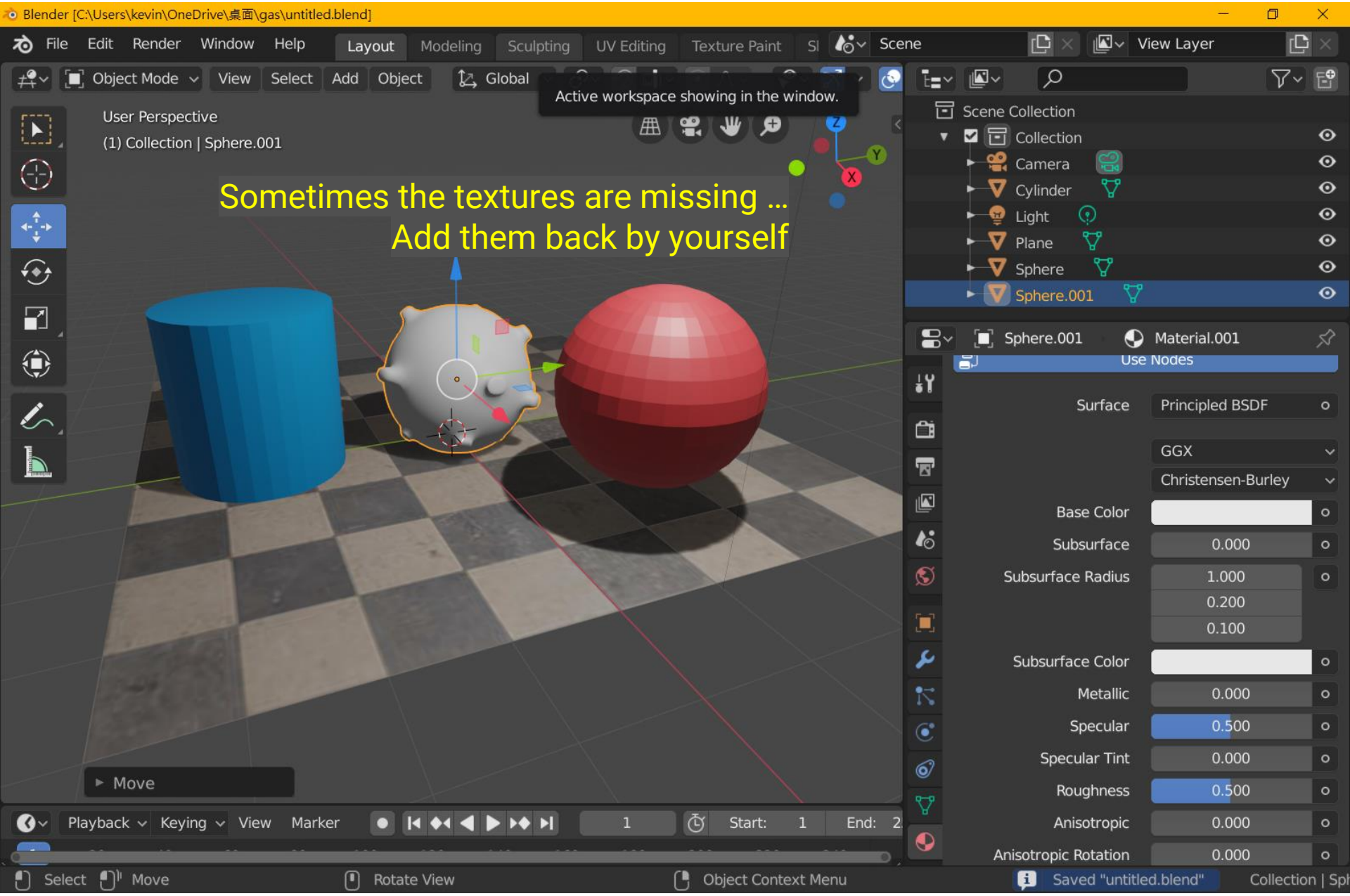
Playback Keying View Marker
1
Start: 1
End: 2
Select
Center View to Mouse
Collection | Plane | Verts:550 | Faces:547 | Tris:


Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File
Edit
Render
Window
Help
Layout
Modeling
Sculpting
UV Editing
Texture Paint
Scene
View Layer
New Ctrl N
Open... Ctrl O
Open Recent Shift Ctrl O
Revert
Recover
Save Ctrl S
Save As... Shift Ctrl S
Save Copy...
Link...
Append...
Data Previews
Import
Export
External Data
Defaults
Quit Ctrl Q
For *.blend scene file (but will start a new scene)
Try to import a 3D model
For pure 3D model
Collada (Default) (.dae)
Alembic (.abc)
FBX (.fbx)
Motion Capture (.bvh)
Stanford (.ply)
Wavefront (.obj)
X3D Extensible 3D (.x3d/.wrl)
Stl (.stl)
Scalable Vector Graphics (.svg)
glTF 2.0 (.glb/.gltf)
Load a FBX file.
Choose one depending on your extension type
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Plane
PlaneMtl
Use Nodes
Surface
Principled BSDF
GGX
Christensen-Burley
Base Color
checkboard_tex.jpg
Linear
Flat
Repeat
Single Image
Color Spa..
sRGB
Vector
Default
Subsurface
0.000
Subsurface Radius
1.000
0.200
0.100
Playback
Keying
View
Marker
Start:
End:
Select
Move
Rotate View
Object Context Menu
Collection | Plane | Verts:550 | Faces:547


Blender [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
Active workspace showing in the window.
User Perspective
(1) Collection | Sphere.001
Sometimes the textures are missing ...
Add them back by yourself
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Material.001
Use Nodes
Surface
Principled BSDF
GGX
Christensen-Burley
Base Color
Subsurface
0.000
Subsurface Radius
1.000
0.200
0.100
Subsurface Color
Metallic
0.000
Specular
0.500
Specular Tint
0.000
Roughness
0.500
Anisotropic
0.000
Anisotropic Rotation
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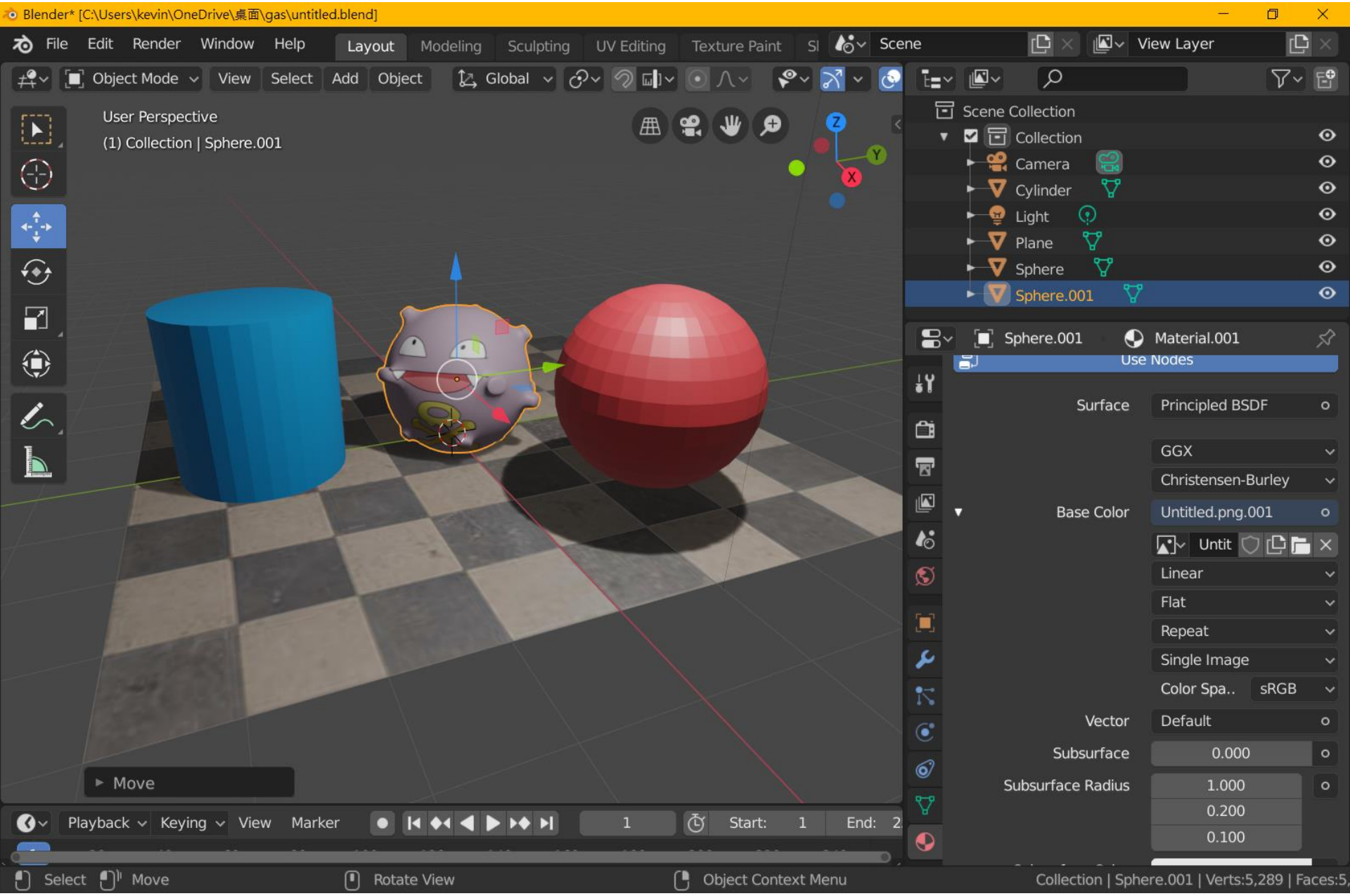
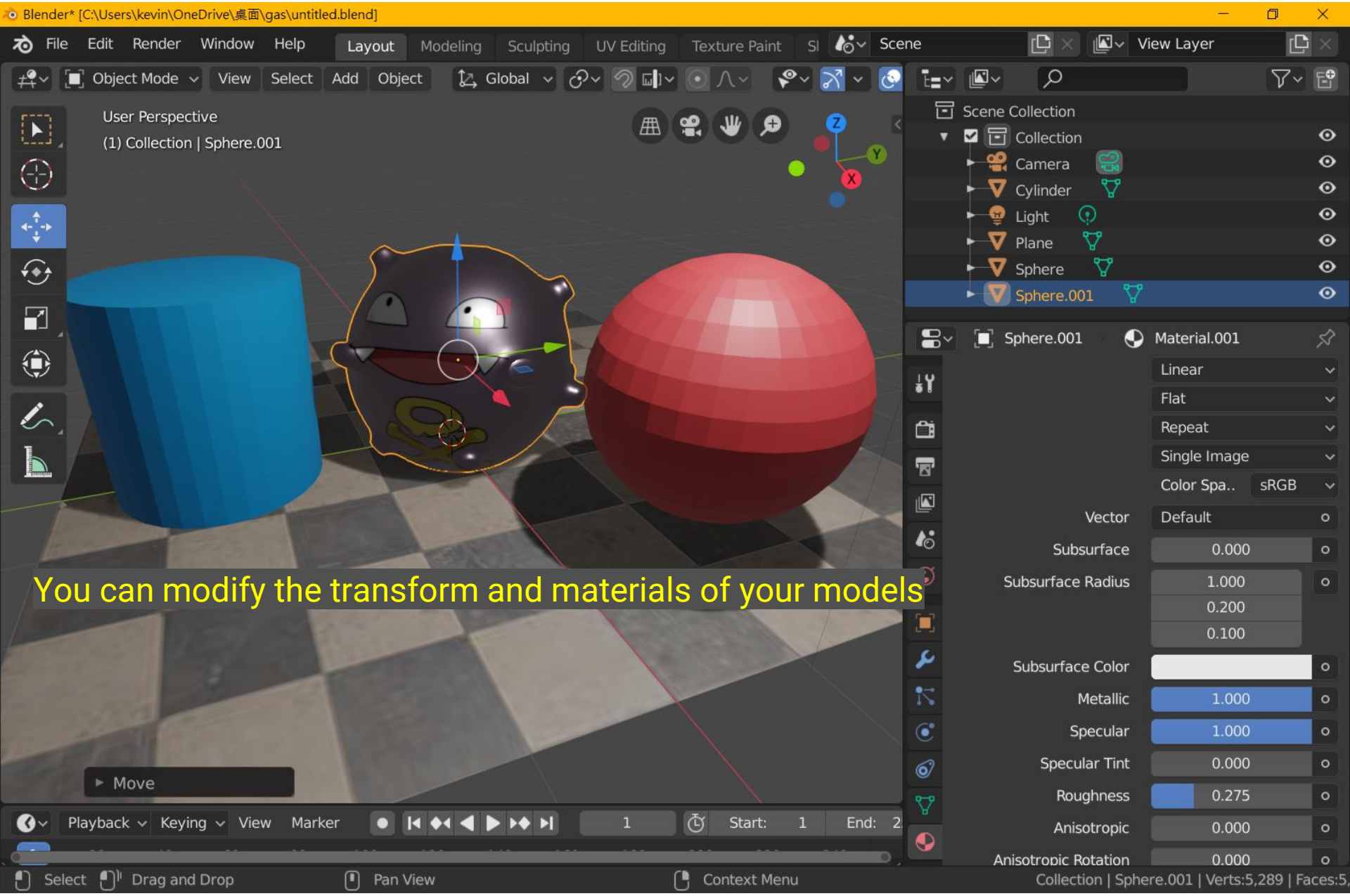
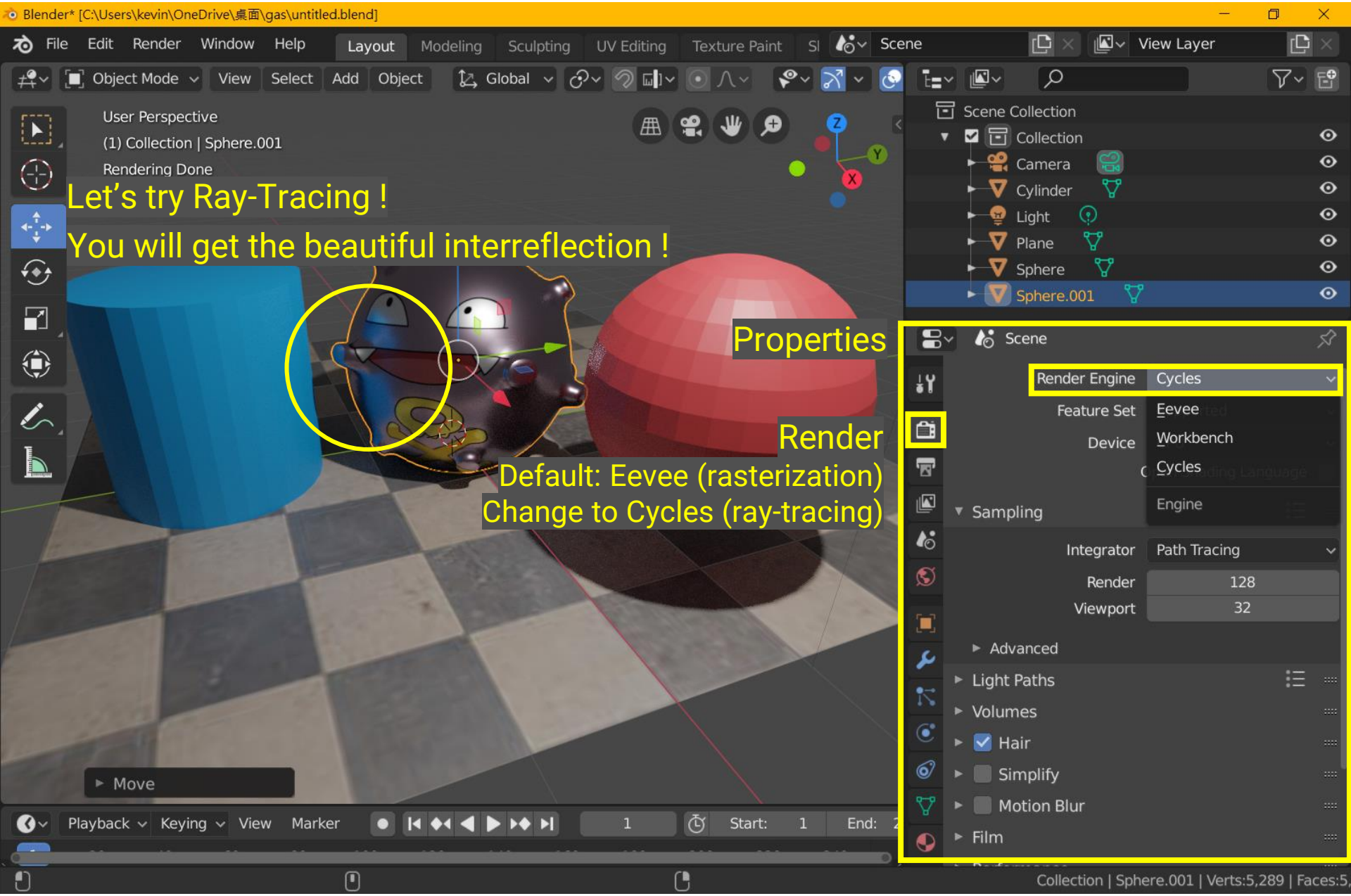
Move
Playback Keying View Marker
1
Start: 1
End:
Select
Move
Rotate View
Object Context Menu
Saved "untitled.blend"
Collection | Sph

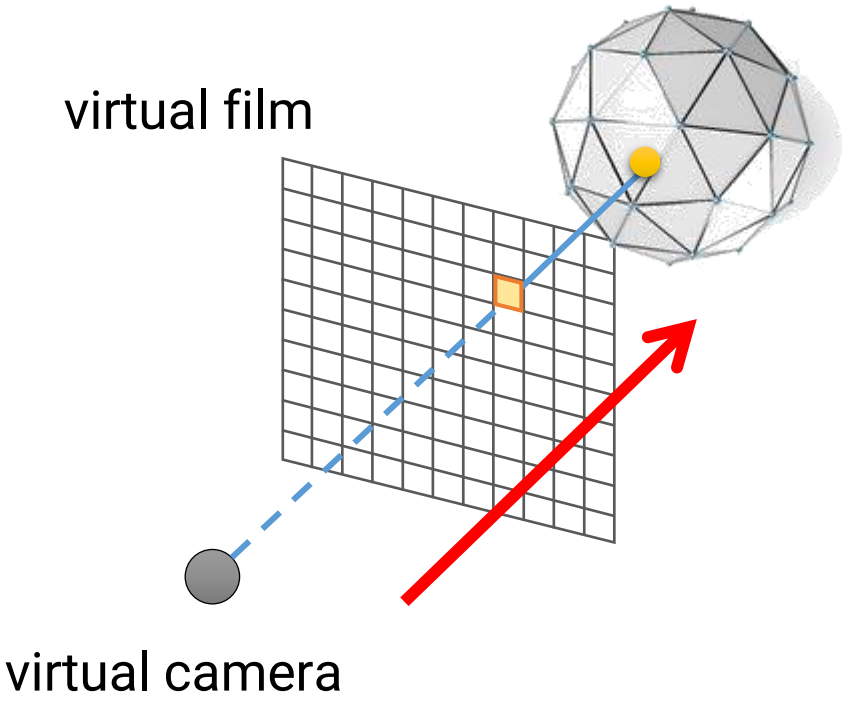

Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Sphere.001
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Sphere.001
Material.001
Use Nodes
Surface
Principled BSDF
GGX
Christensen-Burley
Base Color
Untitled.png.001
Linear
Flat
Repeat
Single Image
Color Spa..
sRGB
Vector
Default
Subsurface
0.000
Subsurface Radius
1.000
0.200
0.100
Move
Playback Keying View Marker
Start: 1
End:
Select
Move
Rotate View
Object Context Menu
Collection | Sphere.001 | Verts:5,289 | Faces:5,


Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Sphere.001
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Material.001
Linear
Flat
Repeat
Single Image
Color Spa..
sRGB
Vector
Default
Subsurface
0.000
Subsurface Radius
1.000
0.200
0.100
Subsurface Color
Metallic
1.000
Specular
1.000
Specular Tint
0.000
Roughness
0.275
Anisotropic
0.000
Anisotropic Rotation
0.000
You can modify the transform and materials of your models
Move
Playback Keying View Marker
1
Start: 1
End: 2
Select
Drag and Drop
Pan View
Context Menu
Collection | Sphere.001 | Verts:5,289 | Faces:5,

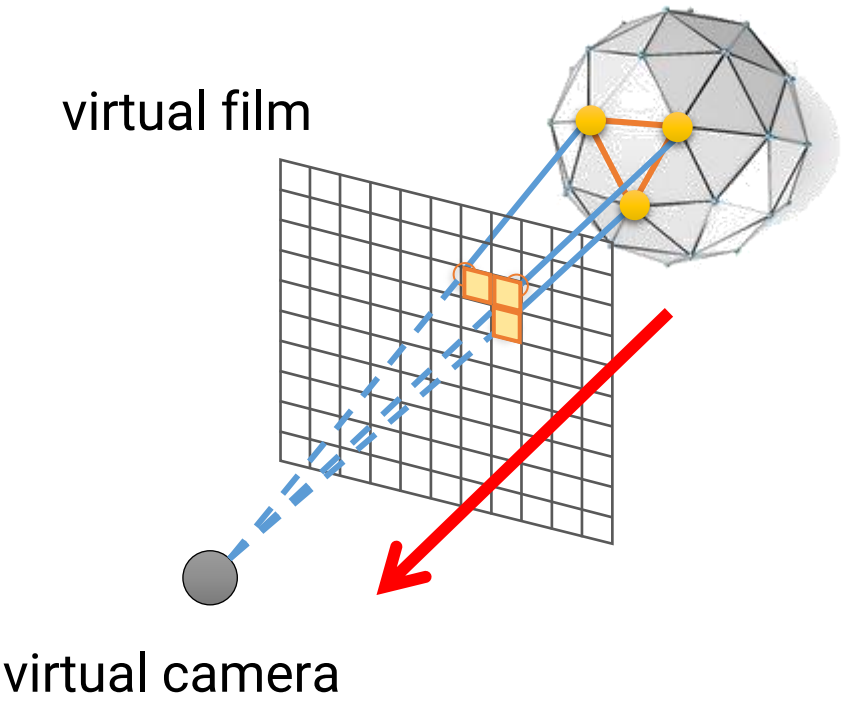

Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Sphere.001
Rendering Done
Let's try Ray-Tracing !
You will get the beautiful interreflection !
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Properties
Render
Default: Eevee (rasterization)
Change to Cycles (ray-tracing)
Render Engine
Cycles
Feature Set
Eevee
Device
Workbench
Cycles
Engine
Sampling
Integrator
Path Tracing
Render
128
Viewport
32
Advanced
Light Paths
Volumes
Hair
Simplify
Motion Blur
Film
Move
Playback Keying View Marker
Start: 1
End:
Collection | Sphere.001 | Verts:5,289 | Faces:5,

Recap: Bring Triangles into Pixels

Ray Tracing

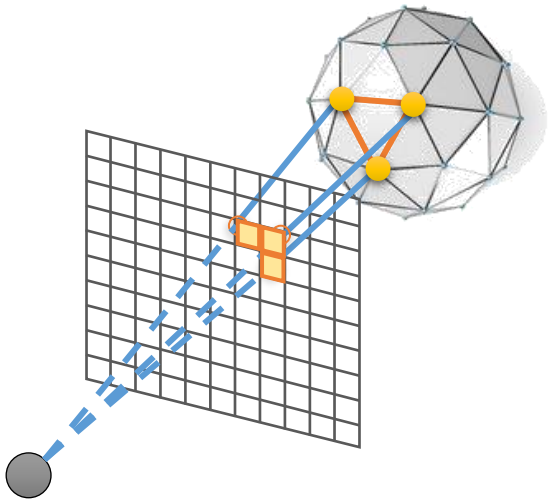


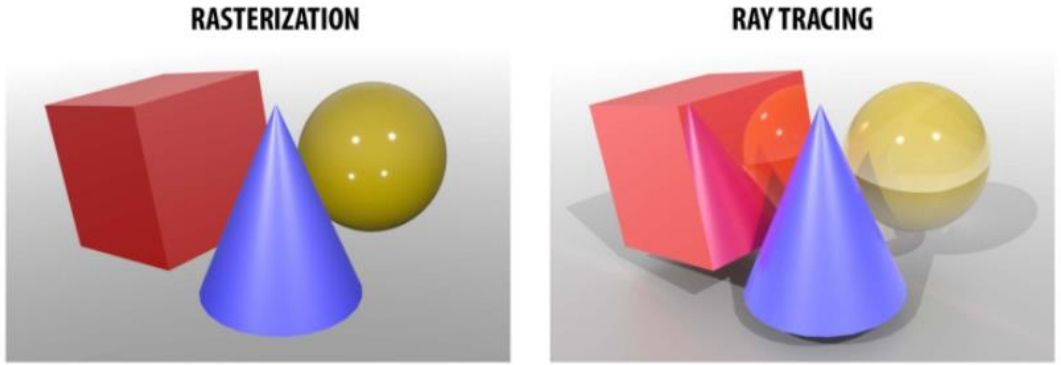
Rasterization



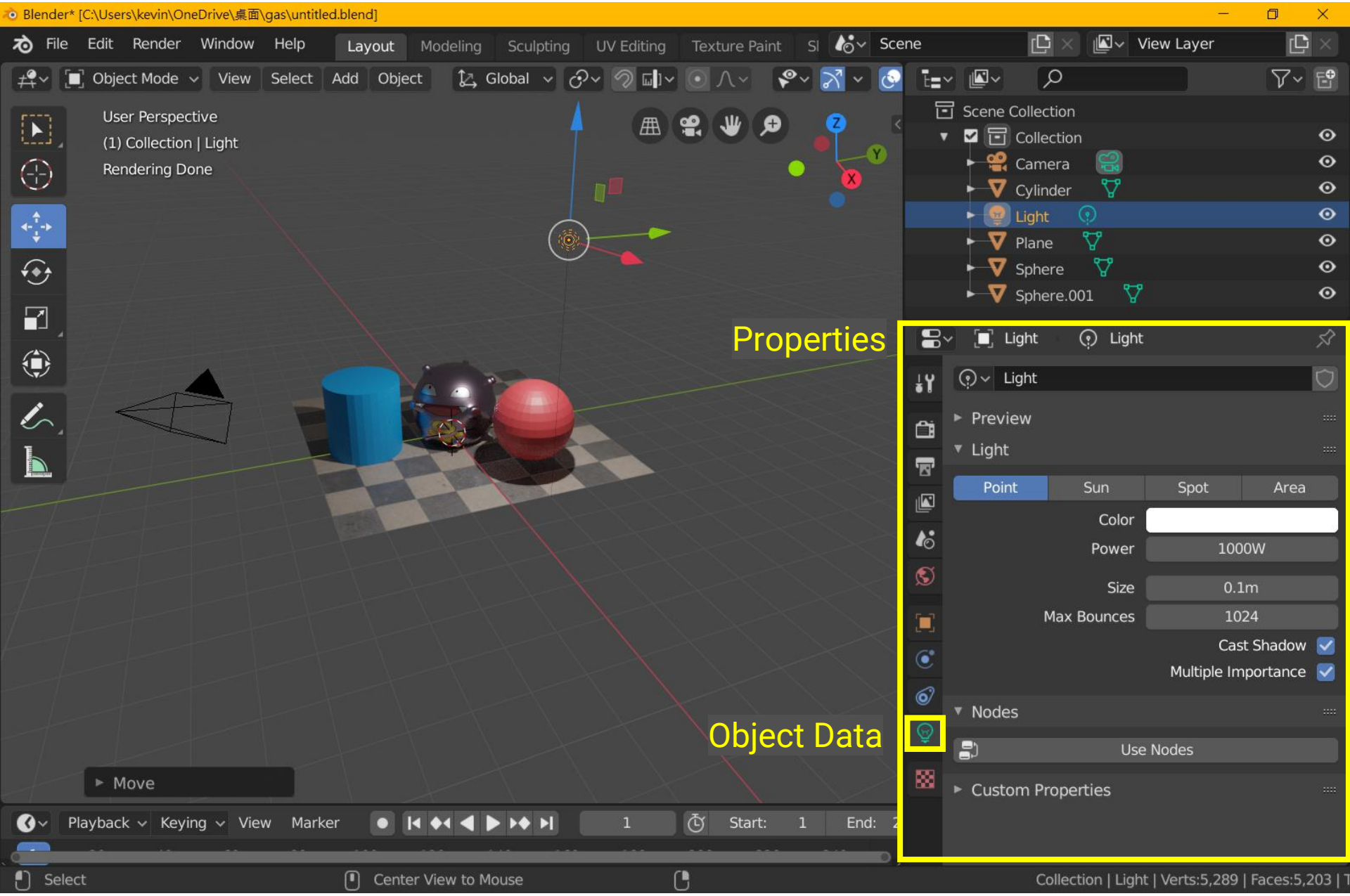
Recap: Rasterization v.s. Ray Tracing

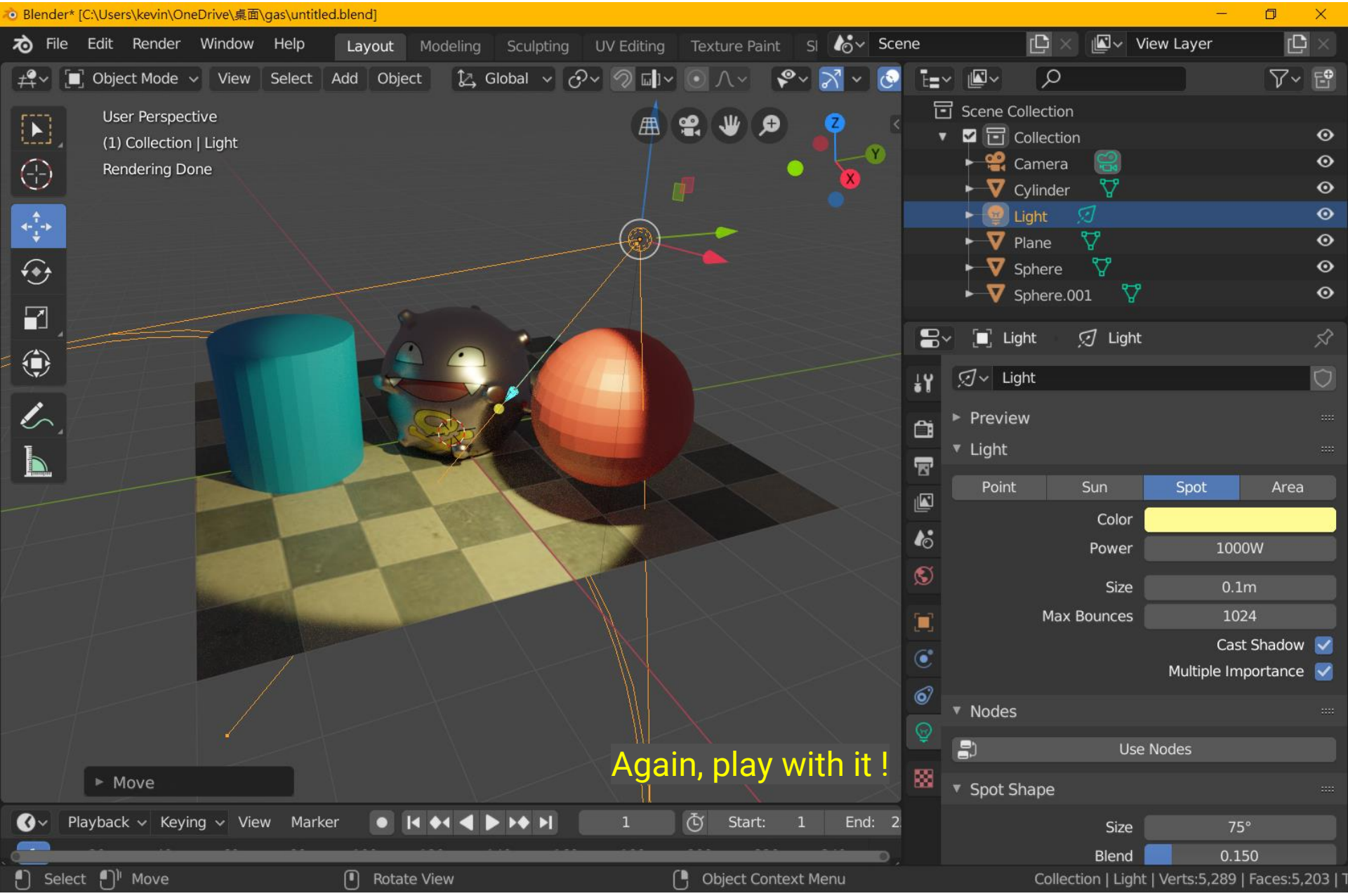
- Rasterization is more friendly to hardware and usually has higher parallelism
- But it is more difficult to simulate effects such as reflection, refraction, shadows, and global illumination
  - Need specialized algorithms





Lights


Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Light
Rendering Done
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Properties
Light
Preview
Point Sun Spot Area
Color
Power 1000W
Size 0.1m
Max Bounces 1024
Cast Shadow
Multiple Importance
Nodes
Use Nodes
Custom Properties
Object Data
Move
Playback Keying View Marker
Start: 1
End:
Select
Center View to Mouse
Collection | Light | Verts:5,289 | Faces:5,203


Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Light
Rendering Done
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Light
Preview
Point Sun Spot Area
Color
Power 1000W
Size 0.1m
Max Bounces 1024
Cast Shadow
Multiple Importance
Nodes
Use Nodes
Spot Shape
Size 75°
Blend 0.150
Again, play with it !
Move
Playback Keying View Marker
Start: 1
End:
Select Move Rotate View Object Context Menu
Collection | Light | Verts:5,289 | Faces:5,203

Recap: Lights in Computer Graphics

- Point light
- Spot light
- Area light

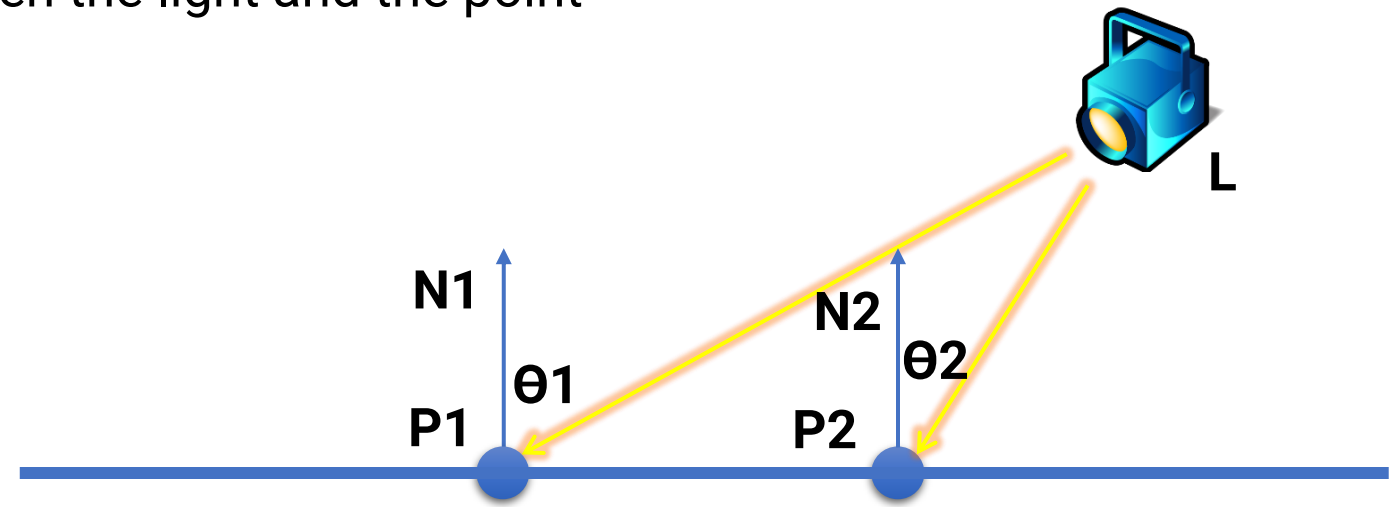
} local lights

- Directional light
- Environment light

} distant lights

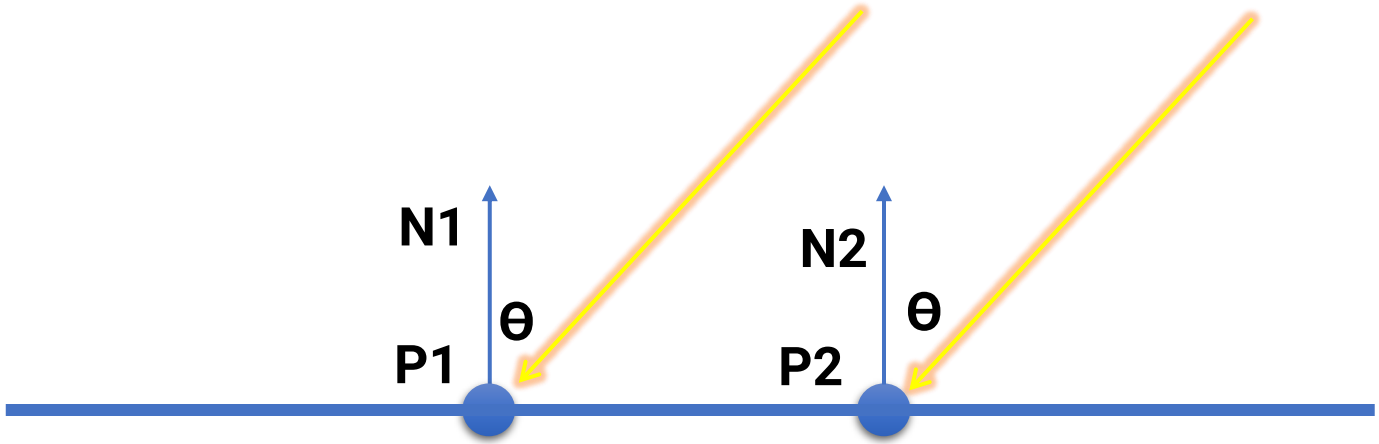
Recap: Local Lights

- The distance between a light and a surface is **not** long enough compared to the scene scale
- The position of a light need to be taken into account during shading
  - **Lighting direction = |L – P|**
  - **Lighting attenuation** is proportional to the square of distance between the light and the point

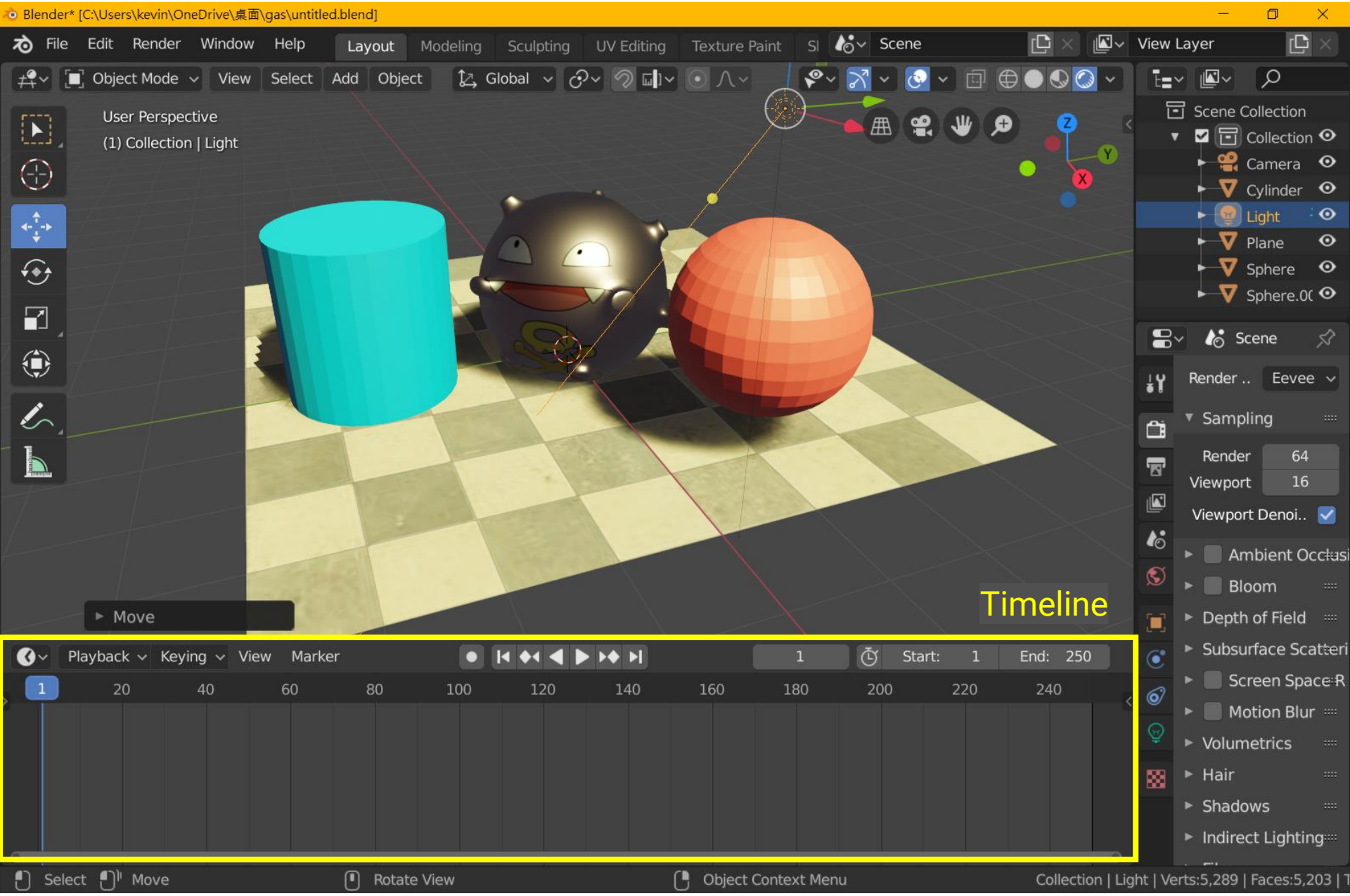


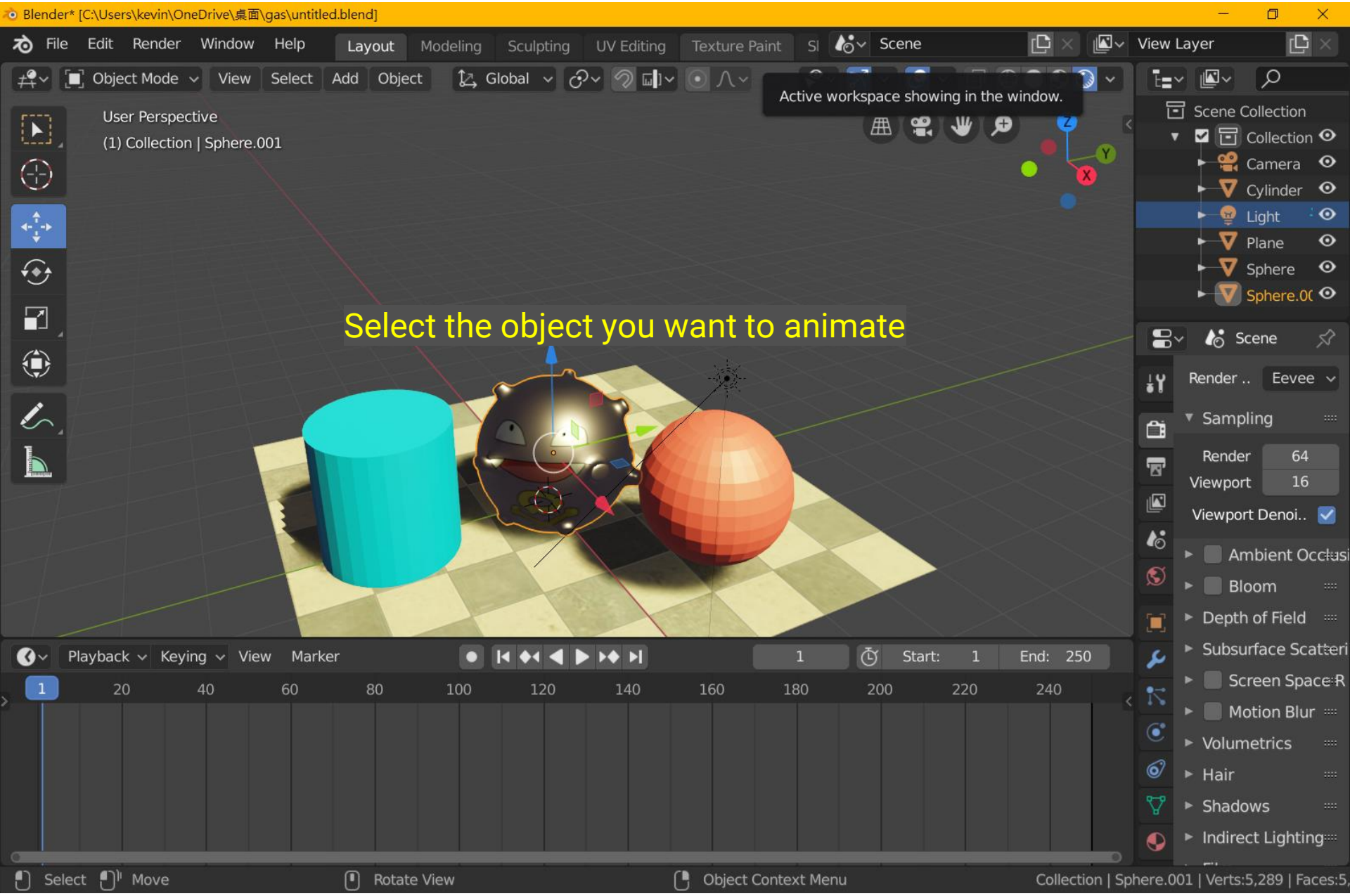
Recap: Distant Lights

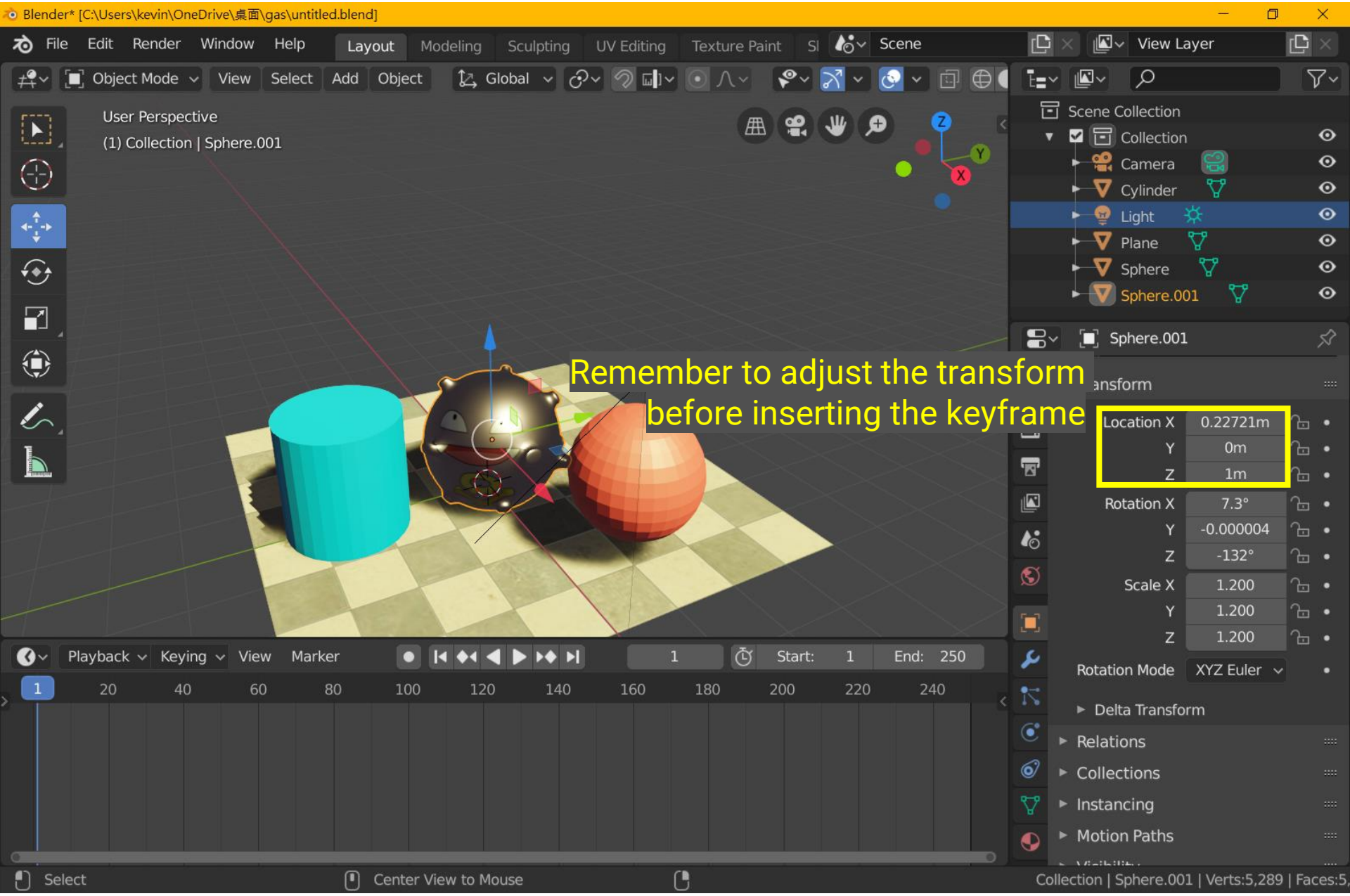
- The distance between a light and a surface is long enough compared to the scene scale and **can be ignored**
  - **Lighting direction** is **fixed**
  - **No lighting attenuation**
- **Directional light (sun)** is the most common distant light

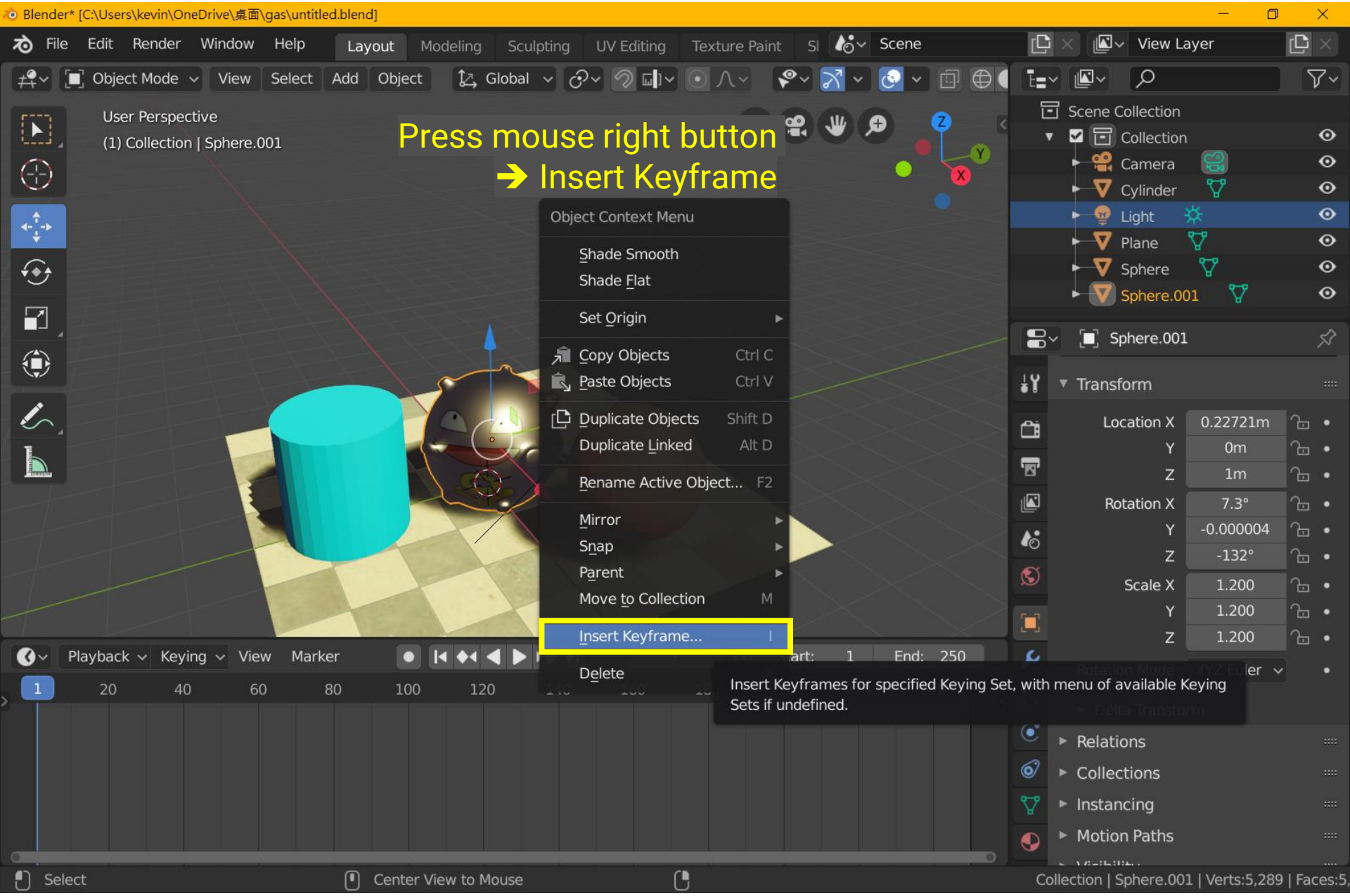


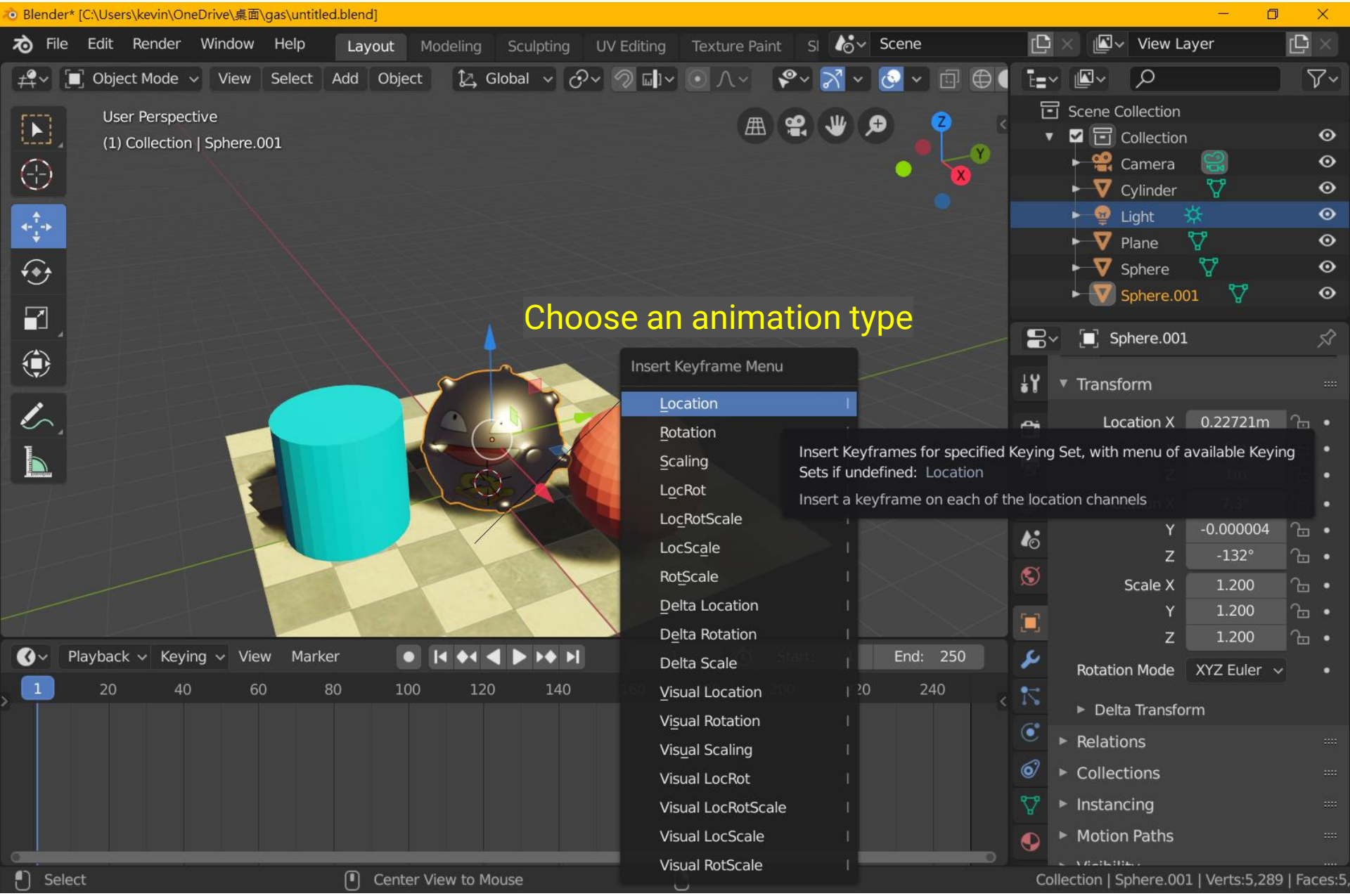
Animation

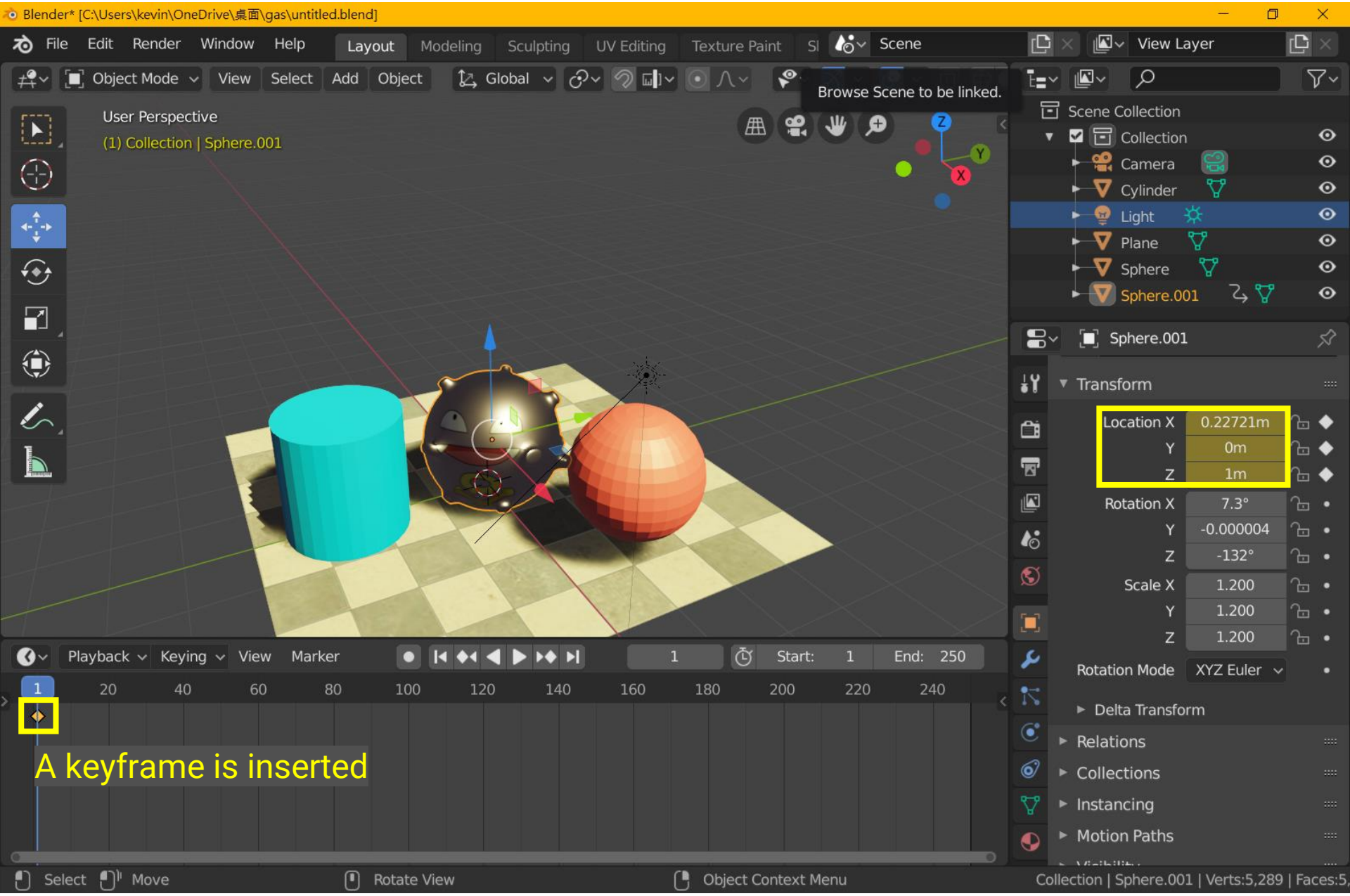

Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Light
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Render .. Eevee
Sampling
Render 64
Viewport 16
Viewport Denoi..
Ambient Occlusi
Bloom
Depth of Field
Subsurface Scatteri
Screen Space R
Motion Blur
Volumetrics
Hair
Shadows
Indirect Lighting
Move
Timeline
Playback Keying View Marker
1
Start: 1
End: 250
1 20 40 60 80 100 120 140 160 180 200 220 240
Select
Move
Rotate View
Object Context Menu
Collection | Light | Verts:5,289 | Faces:5,203

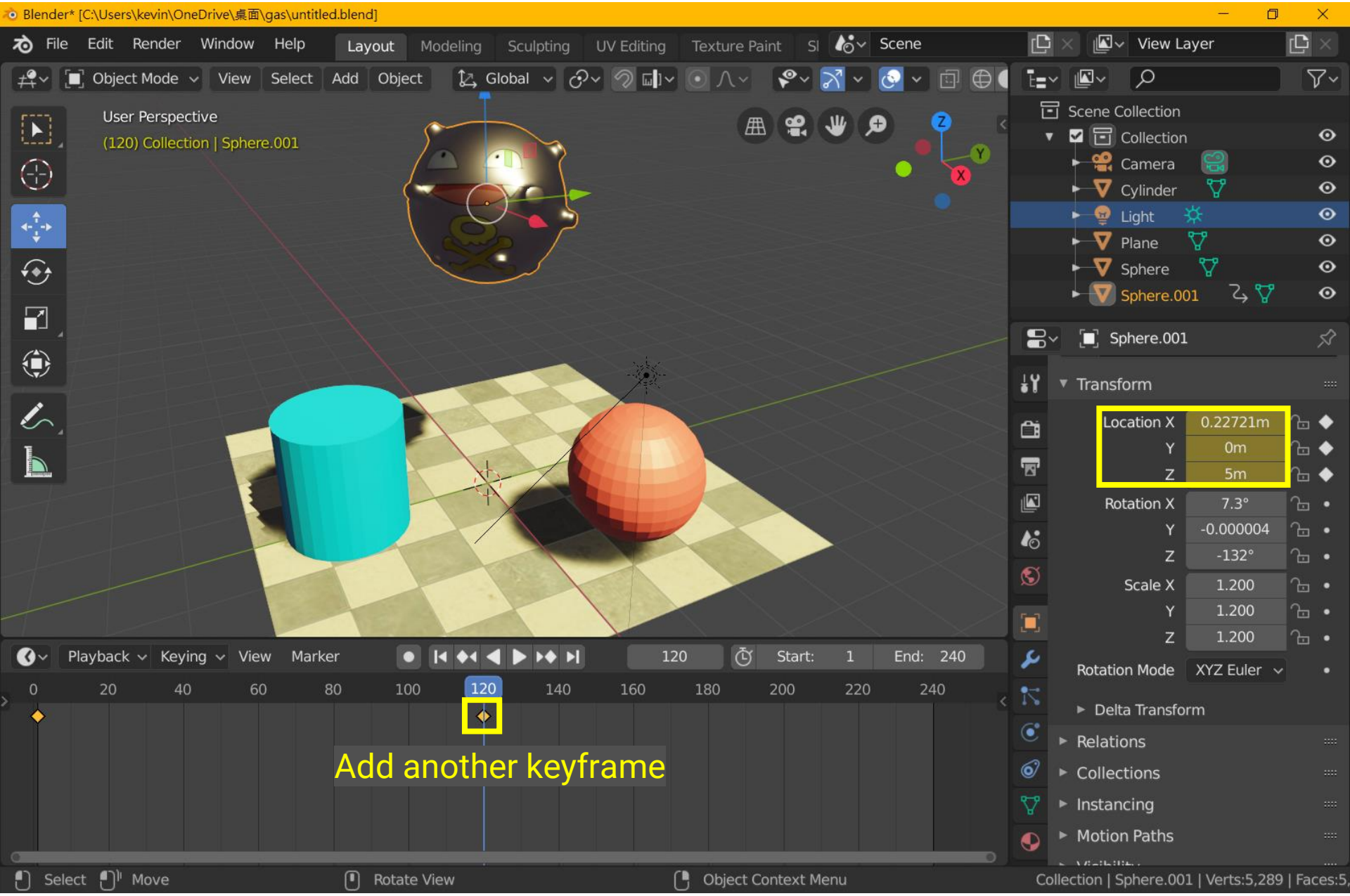

Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
Active workspace showing in the window.
User Perspective
(1) Collection | Sphere.001
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Select the object you want to animate
Render .. Eevee
Sampling
Render 64
Viewport 16
Viewport Denoi..
Ambient Occlusi
Bloom
Depth of Field
Subsurface Scatteri
Screen Space R
Motion Blur
Volumetrics
Hair
Shadows
Indirect Lighting
Playback Keying View Marker
1
Start: 1
End: 250
1 20 40 60 80 100 120 140 160 180 200 220 240
Select
Move
Rotate View
Object Context Menu
Collection | Sphere.001 | Verts:5,289 | Faces:5,

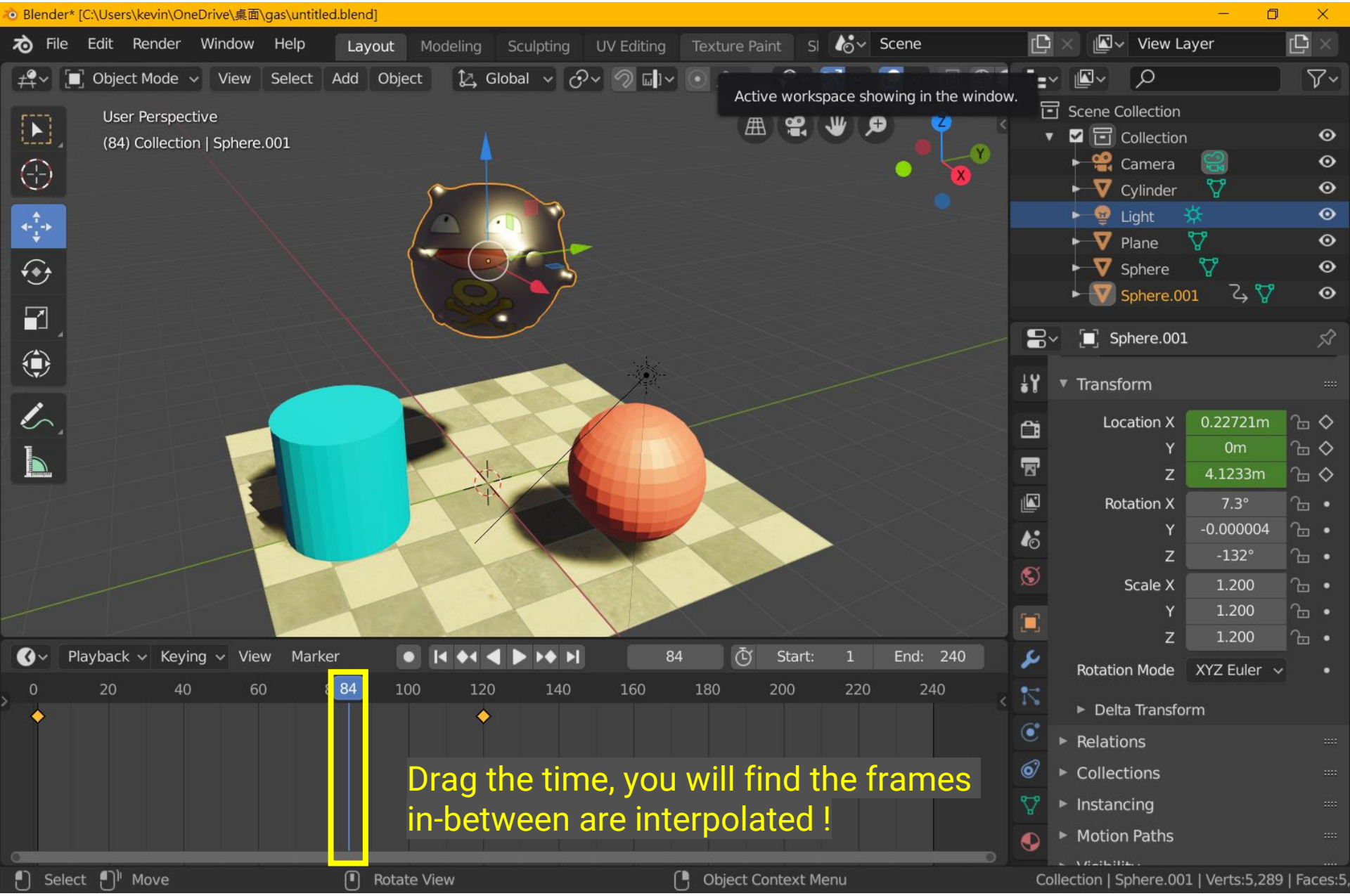

Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Sphere.001
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Remember to adjust the transform
before inserting the keyframe
Location X 0.22721m
Y 0m
Z 1m
Rotation X 7.3°
Y -0.000004
Z -132°
Scale X 1.200
Y 1.200
Z 1.200
Rotation Mode XYZ Euler
Delta Transform
Relations
Collections
Instancing
Motion Paths
Playback Keying View Marker
Start: 1 End: 250
Select
Center View to Mouse
Collection | Sphere.001 | Verts:5,289 | Faces:5,

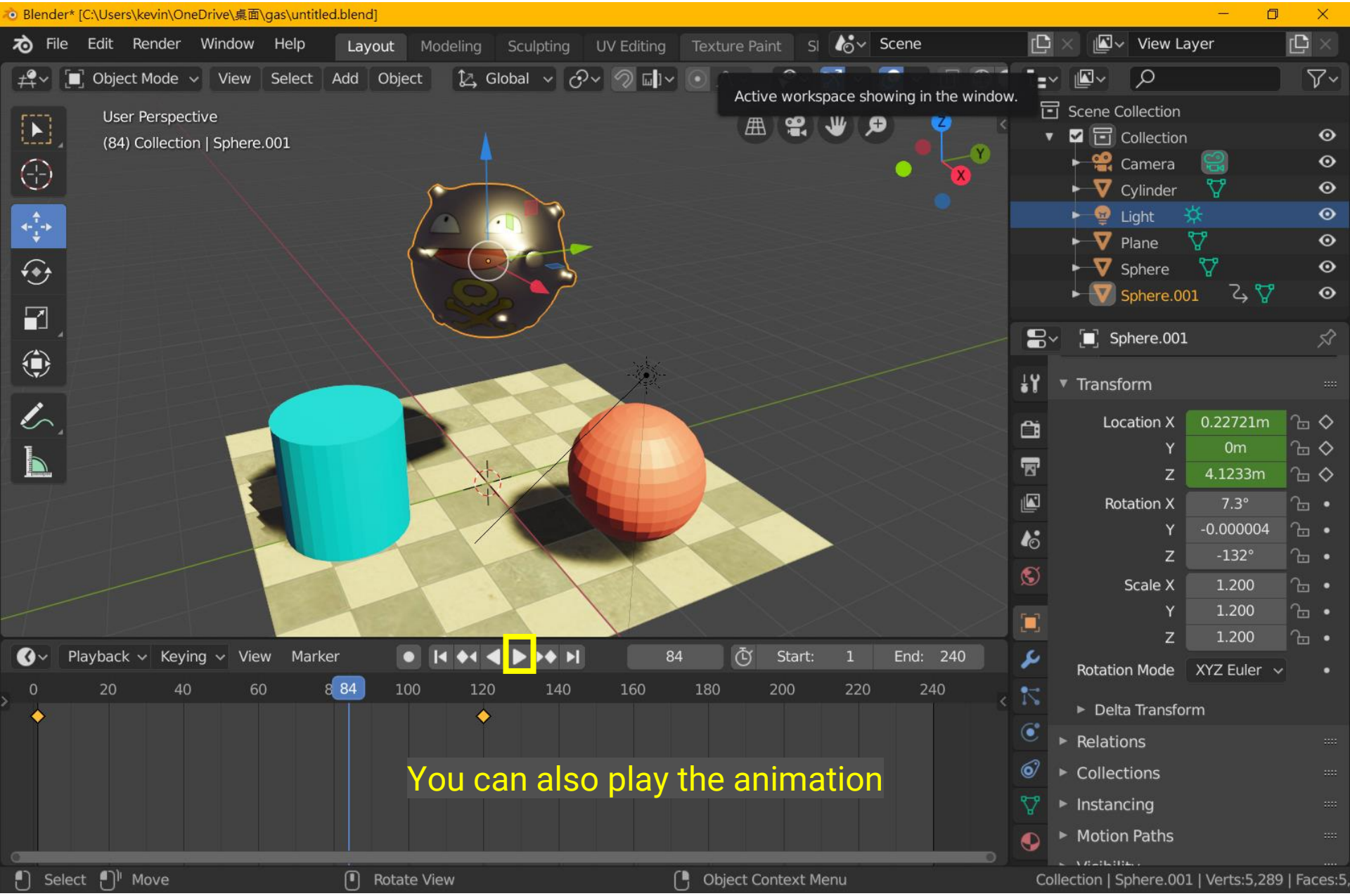

Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Sphere.001
Press mouse right button
➔ Insert Keyframe
Object Context Menu
Shade Smooth
Shade Flat
Set Origin
Copy Objects Ctrl C
Paste Objects Ctrl V
Duplicate Objects Shift D
Duplicate Linked Alt D
Rename Active Object... F2
Mirror
Snap
Parent
Move to Collection M
Insert Keyframe... I
Delete
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Transform
Location X 0.22721m
Y 0m
Z 1m
Rotation X 7.3°
Y -0.000004
Z -132°
Scale X 1.200
Y 1.200
Z 1.200
Relations
Collections
Instancing
Motion Paths
Playback Keying View Marker
End: 250
Insert Keyframes for specified Keying Set, with menu of available Keying Sets if undefined.
Select
Center View to Mouse
Collection | Sphere.001 | Verts:5,289 | Faces:5,

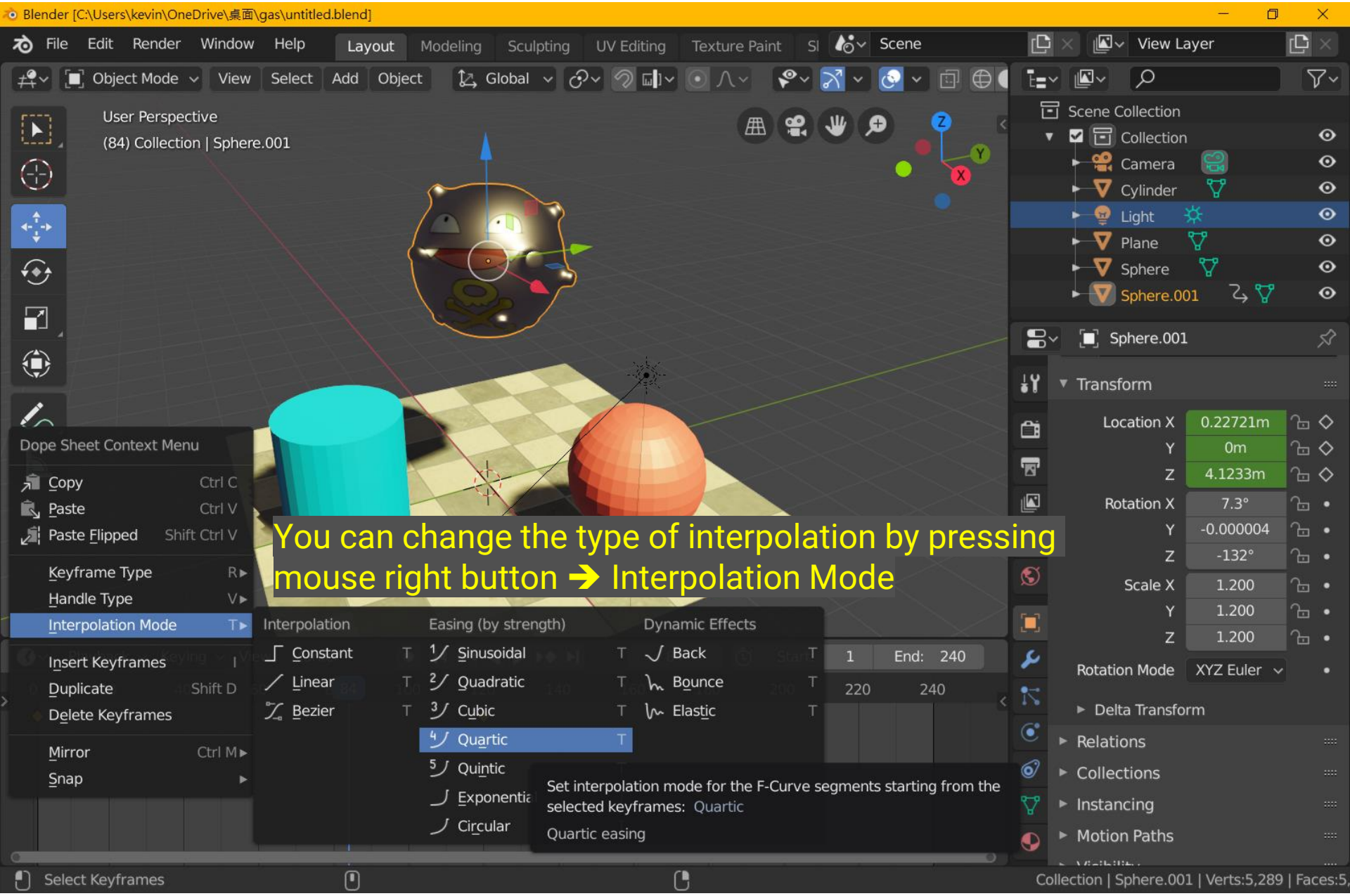

Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(1) Collection | Sphere.001
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Choose an animation type
Insert Keyframe Menu
Location
Rotation
Scaling
LocRot
LocRotScale
LocScale
RotScale
Delta Location
Delta Rotation
Delta Scale
Visual Location
Visual Rotation
Visual Scaling
Visual LocRot
Visual LocRotScale
Visual LocScale
Visual RotScale
Insert Keyframes for specified Keying Set, with menu of available Keying Sets if undefined: Location
Insert a keyframe on each of the location channels
Transform
Location X 0.22721m
Y -0.000004
Z -132°
Scale X 1.200
Y 1.200
Z 1.200
Rotation Mode XYZ Euler
Delta Transform
Relations
Collections
Instancing
Motion Paths
Playback Keying View Marker
End: 250
Select
Center View to Mouse
Collection | Sphere.001 | Verts:5,289 | Faces:5,

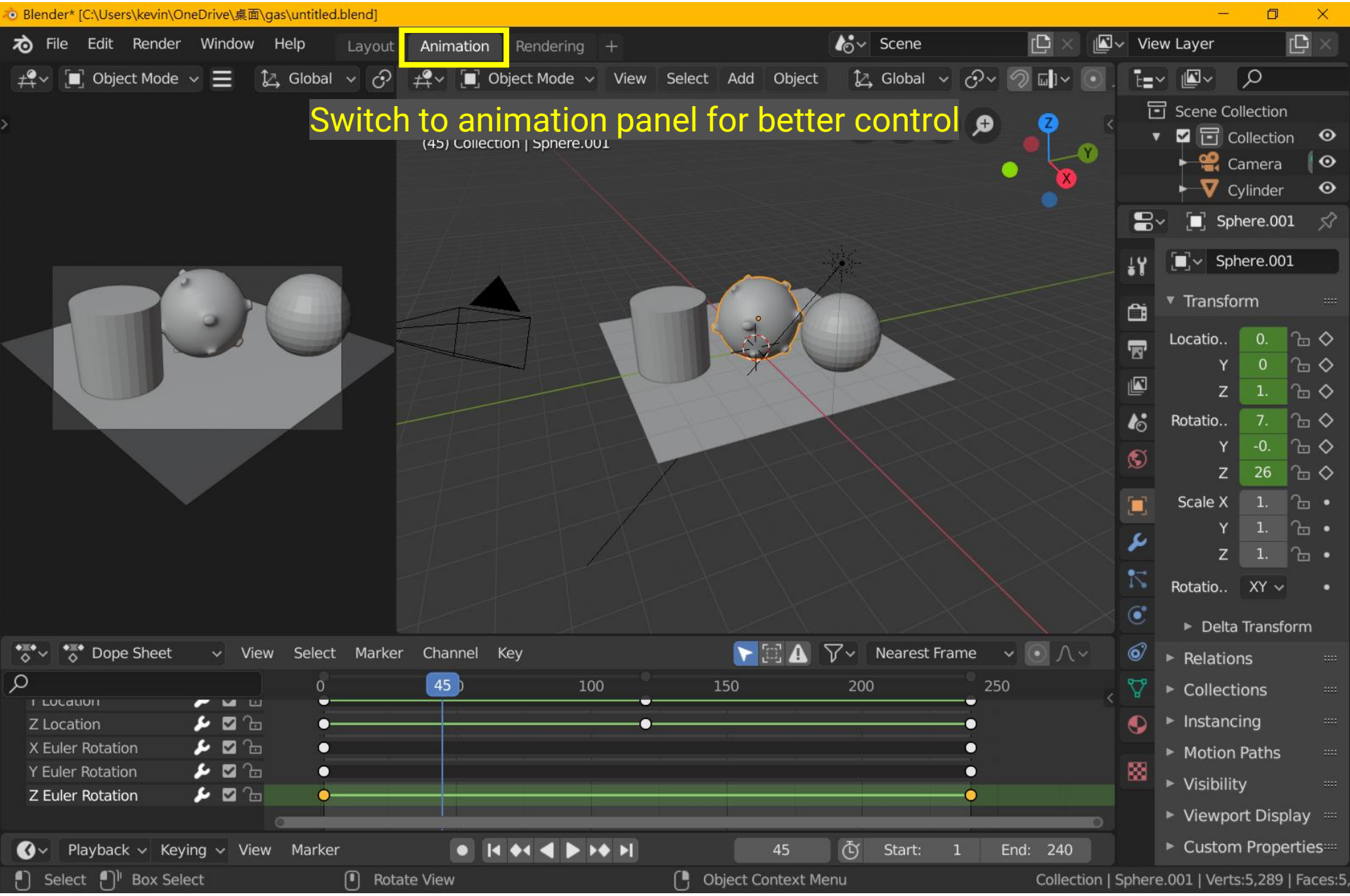

Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
Browse Scene to be linked.
User Perspective
(1) Collection | Sphere.001
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Transform
Location X 0.22721m
Y 0m
Z 1m
Rotation X 7.3°
Y -0.000004
Z -132°
Scale X 1.200
Y 1.200
Z 1.200
Rotation Mode XYZ Euler
Delta Transform
Relations
Collections
Instancing
Motion Paths
Playback Keying View Marker
Start: 1 End: 250
A keyframe is inserted
Select Move Rotate View Object Context Menu
Collection | Sphere.001 | Verts:5,289 | Faces:5,

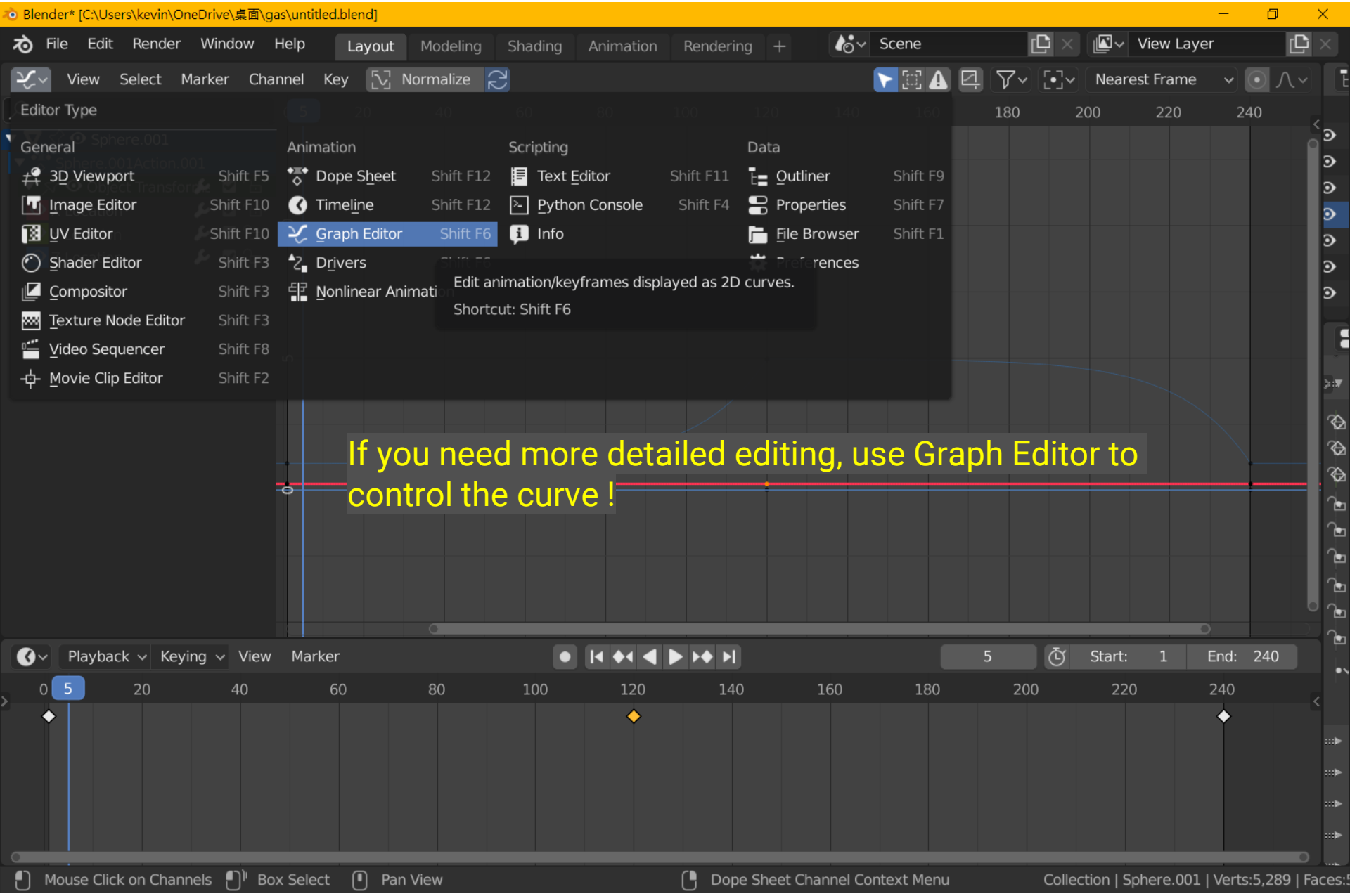

Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(120) Collection | Sphere.001
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Transform
Location X 0.22721m
Y 0m
Z 5m
Rotation X 7.3°
Y -0.000004
Z -132°
Scale X 1.200
Y 1.200
Z 1.200
Rotation Mode XYZ Euler
Delta Transform
Relations
Collections
Instancing
Motion Paths
Playback Keying View Marker
120
Start: 1
End: 240
0 20 40 60 80 100 120 140 160 180 200 220 240
Add another keyframe
Select Move
Rotate View
Object Context Menu
Collection | Sphere.001 | Verts:5,289 | Faces:5,

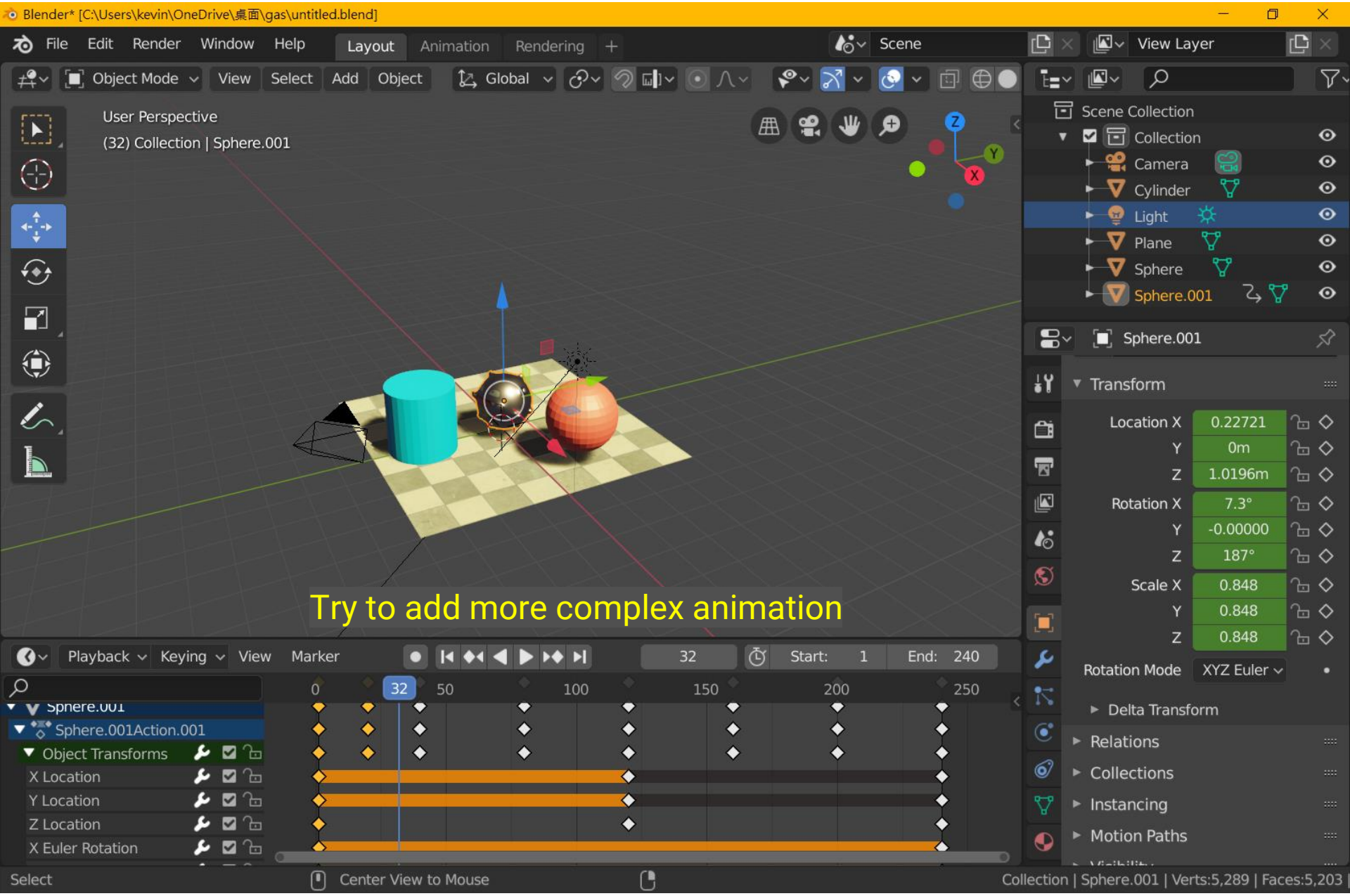

Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
Active workspace showing in the window.
User Perspective
(84) Collection | Sphere.001
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Transform
Location X 0.22721m
Y 0m
Z 4.1233m
Rotation X 7.3°
Y -0.000004
Z -132°
Scale X 1.200
Y 1.200
Z 1.200
Rotation Mode XYZ Euler
Delta Transform
Relations
Collections
Instancing
Motion Paths
Playback Keying View Marker
84
Start: 1
End: 240
0 20 40 60 84 100 120 140 160 180 200 220 240
Drag the time, you will find the frames in-between are interpolated !
Select Move
Rotate View
Object Context Menu
Collection | Sphere.001 | Verts:5,289 | Faces:5,


Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
Active workspace showing in the window.
User Perspective
(84) Collection | Sphere.001
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Transform
Location X 0.22721m
Y 0m
Z 4.1233m
Rotation X 7.3°
Y -0.000004
Z -132°
Scale X 1.200
Y 1.200
Z 1.200
Rotation Mode XYZ Euler
Delta Transform
Relations
Collections
Instancing
Motion Paths
Playback Keying View Marker
84
Start: 1
End: 240
0 20 40 60 84 100 120 140 160 180 200 220 240
You can also play the animation
Select Move
Rotate View
Object Context Menu
Collection | Sphere.001 | Verts:5,289 | Faces:5,

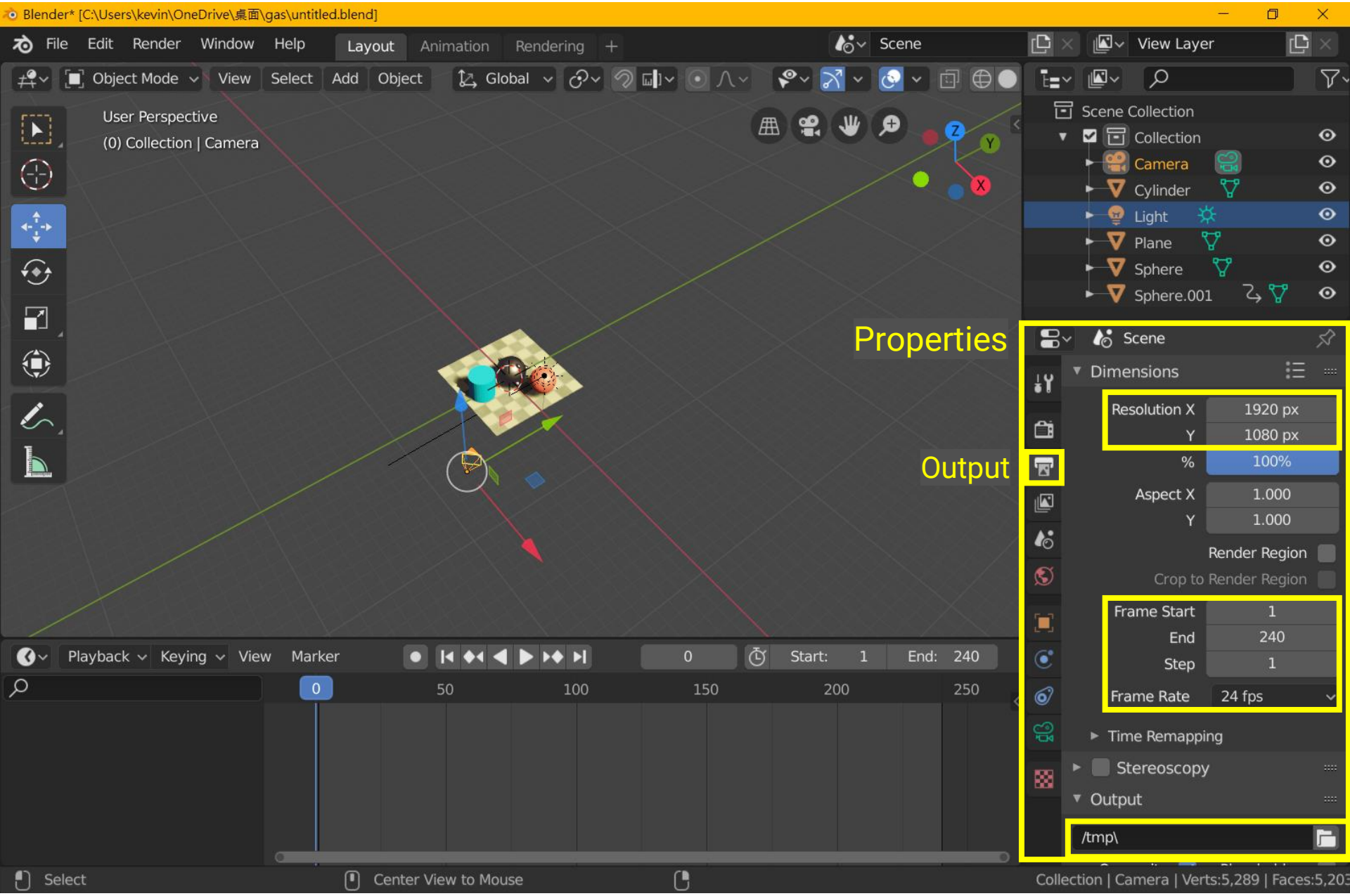

Blender [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(84) Collection | Sphere.001
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Transform
Location X 0.22721m
Y 0m
Z 4.1233m
Rotation X 7.3°
Y -0.000004
Z -132°
Scale X 1.200
Y 1.200
Z 1.200
Rotation Mode XYZ Euler
Delta Transform
Relations
Collections
Instancing
Motion Paths
Dope Sheet Context Menu
Copy Ctrl C
Paste Ctrl V
Paste Flipped Shift Ctrl V
Keyframe Type R
Handle Type V
Interpolation Mode T
Insert Keyframes I
Duplicate Shift D
Delete Keyframes
Mirror Ctrl M
Snap
You can change the type of interpolation by pressing mouse right button ➔ Interpolation Mode
Interpolation
Constant T
Linear T
Bezier T
Easing (by strength)
Sinusoidal T
Quadratic T
Cubic T
Quartic T
Quintic
Exponentia
Circular
Dynamic Effects
Back T
Bounce T
Elastic T
Set interpolation mode for the F-Curve segments starting from the selected keyframes: Quartic
Quartic easing
1 End: 240
220 240
Select Keyframes
Collection | Sphere.001 | Verts:5,289 | Faces:5,

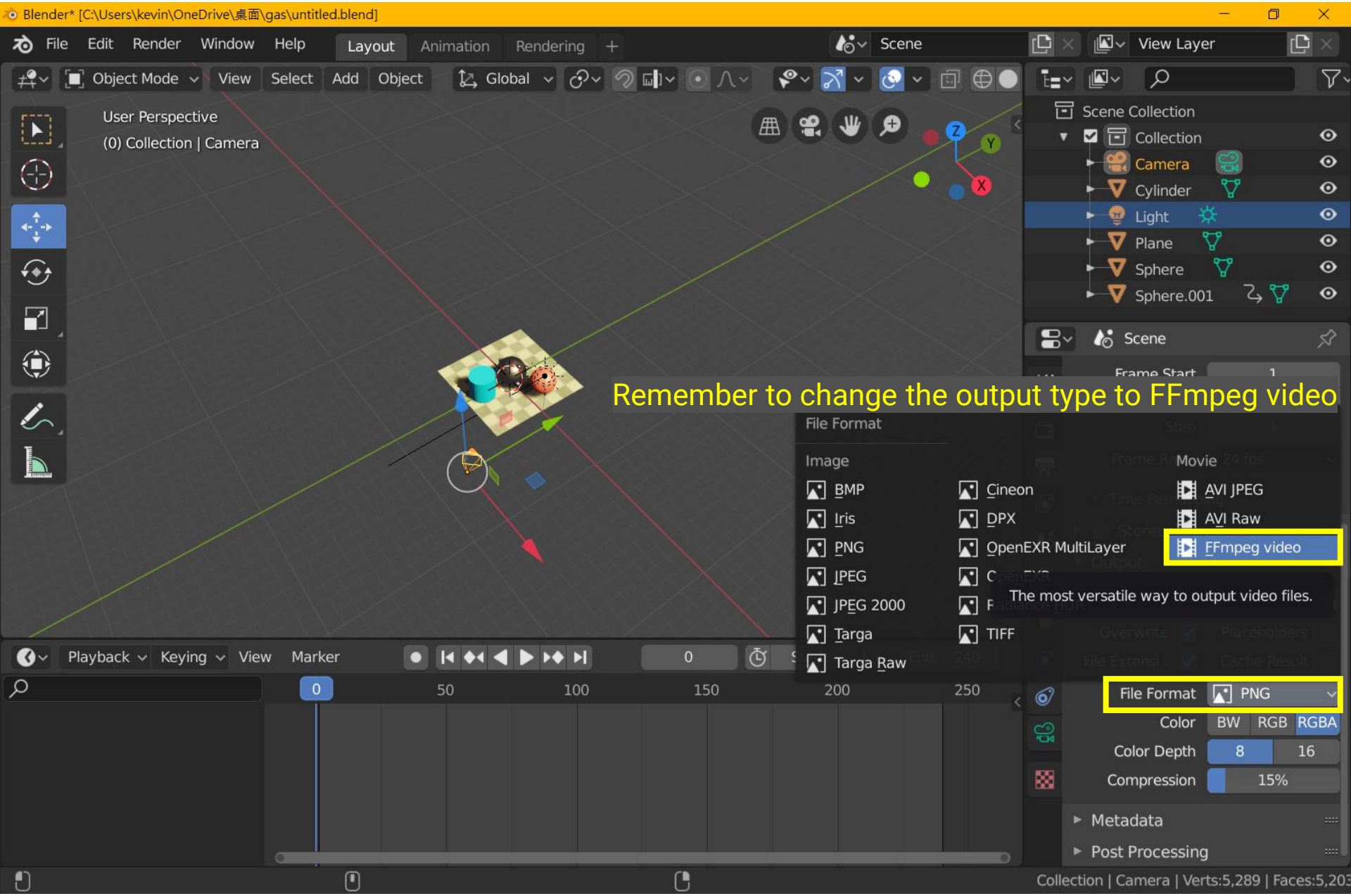

Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Animation Rendering
Scene
View Layer
Object Mode Global
Object Mode View Select Add Object Global
Switch to animation panel for better control
(45) Collection | Sphere.001
Scene Collection
Collection
Camera
Cylinder
Sphere.001
Transform
Locatio.. 0.
Y 0
Z 1.
Rotatio.. 7.
Y -0.
Z 26
Scale X 1.
Y 1.
Z 1.
Rotatio.. XY
Delta Transform
Relations
Collections
Instancing
Motion Paths
Visibility
Viewport Display
Custom Properties
Dope Sheet View Select Marker Channel Key
Nearest Frame
0 45 100 150 200 250
Z Location
X Euler Rotation
Y Euler Rotation
Z Euler Rotation
Playback Keying View Marker
45 Start: 1 End: 240
Select Box Select Rotate View Object Context Menu
Collection | Sphere.001 | Verts:5,289 | Faces:5,

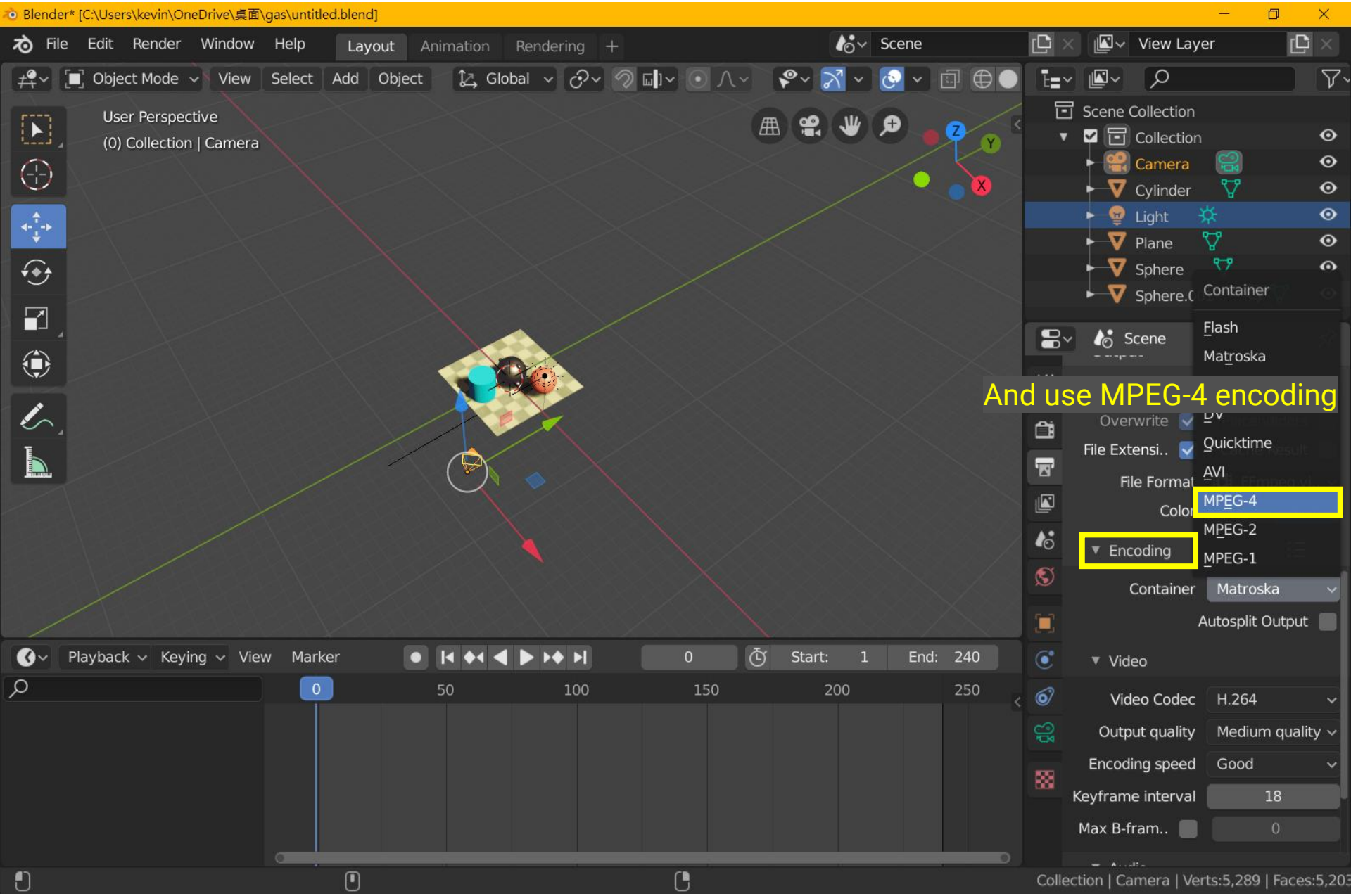

Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Modeling Shading Animation Rendering
Scene
View Layer
View Select Marker Channel Key
Normalize
Nearest Frame
Editor Type
General
3D Viewport Shift F5
Image Editor Shift F10
UV Editor Shift F10
Shader Editor Shift F3
Compositor Shift F3
Texture Node Editor Shift F3
Video Sequencer Shift F8
Movie Clip Editor Shift F2
Animation
Dope Sheet Shift F12
Timeline Shift F12
Graph Editor Shift F6
Drivers
Nonlinear Animati
Scripting
Text Editor Shift F11
Python Console Shift F4
Info
Data
Outliner Shift F9
Properties Shift F7
File Browser Shift F1
Edit animation/keyframes displayed as 2D curves.
Shortcut: Shift F6
If you need more detailed editing, use Graph Editor to control the curve !
Playback Keying View Marker
5
Start: 1
End: 240
Mouse Click on Channels
Box Select
Pan View
Dope Sheet Channel Context Menu
Collection | Sphere.001 | Verts:5,289 | Faces:5

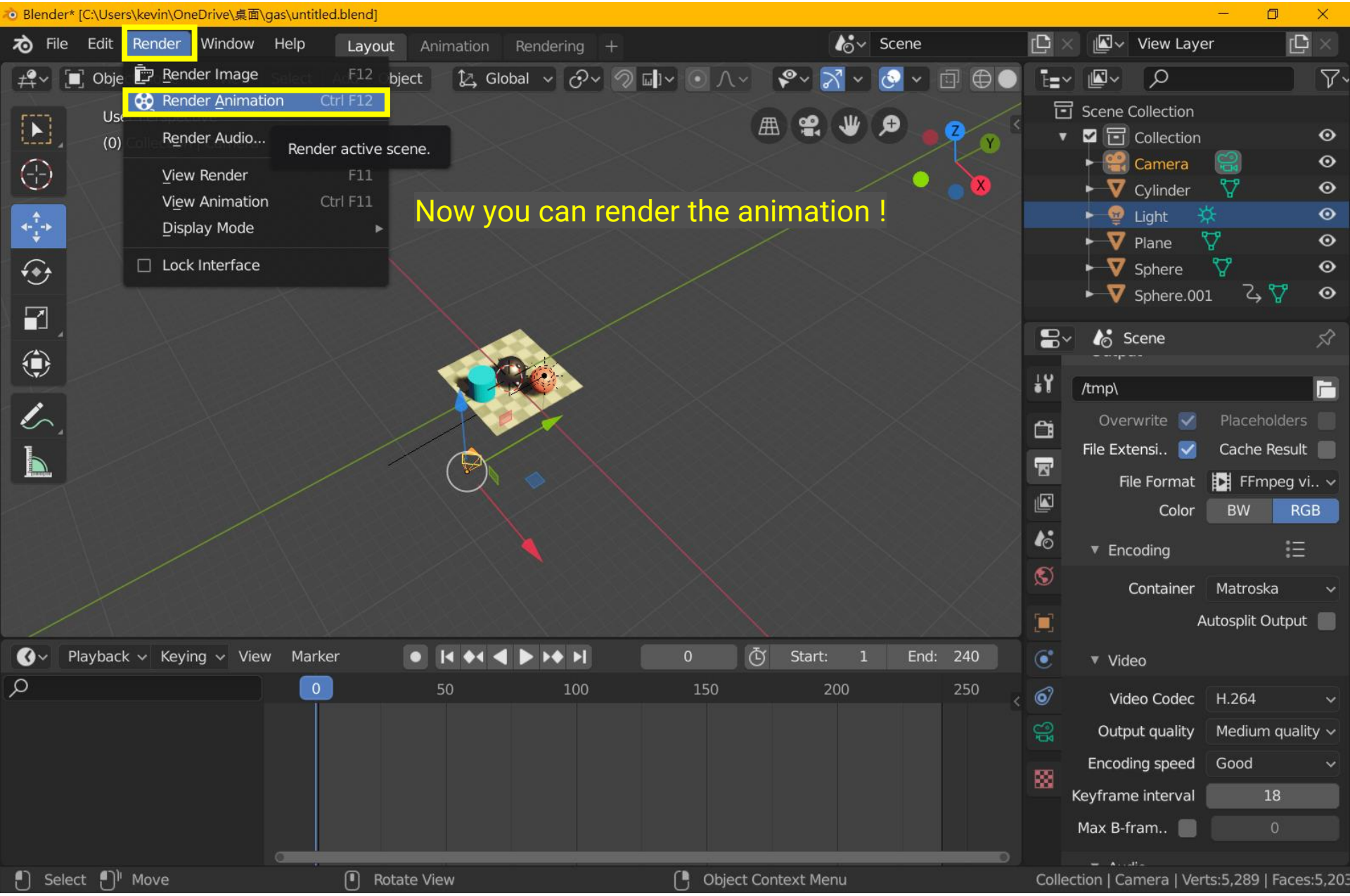

Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Animation Rendering
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(32) Collection | Sphere.001
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Transform
Location X 0.22721
Y 0m
Z 1.0196m
Rotation X 7.3°
Y -0.00000
Z 187°
Scale X 0.848
Y 0.848
Z 0.848
Rotation Mode XYZ Euler
Delta Transform
Relations
Collections
Instancing
Motion Paths
Try to add more complex animation
Playback Keying View Marker
32
Start: 1
End: 240
Sphere.001Action.001
Object Transforms
X Location
Y Location
Z Location
X Euler Rotation
Select
Center View to Mouse
Collection | Sphere.001 | Verts:5,289 | Faces:5,203

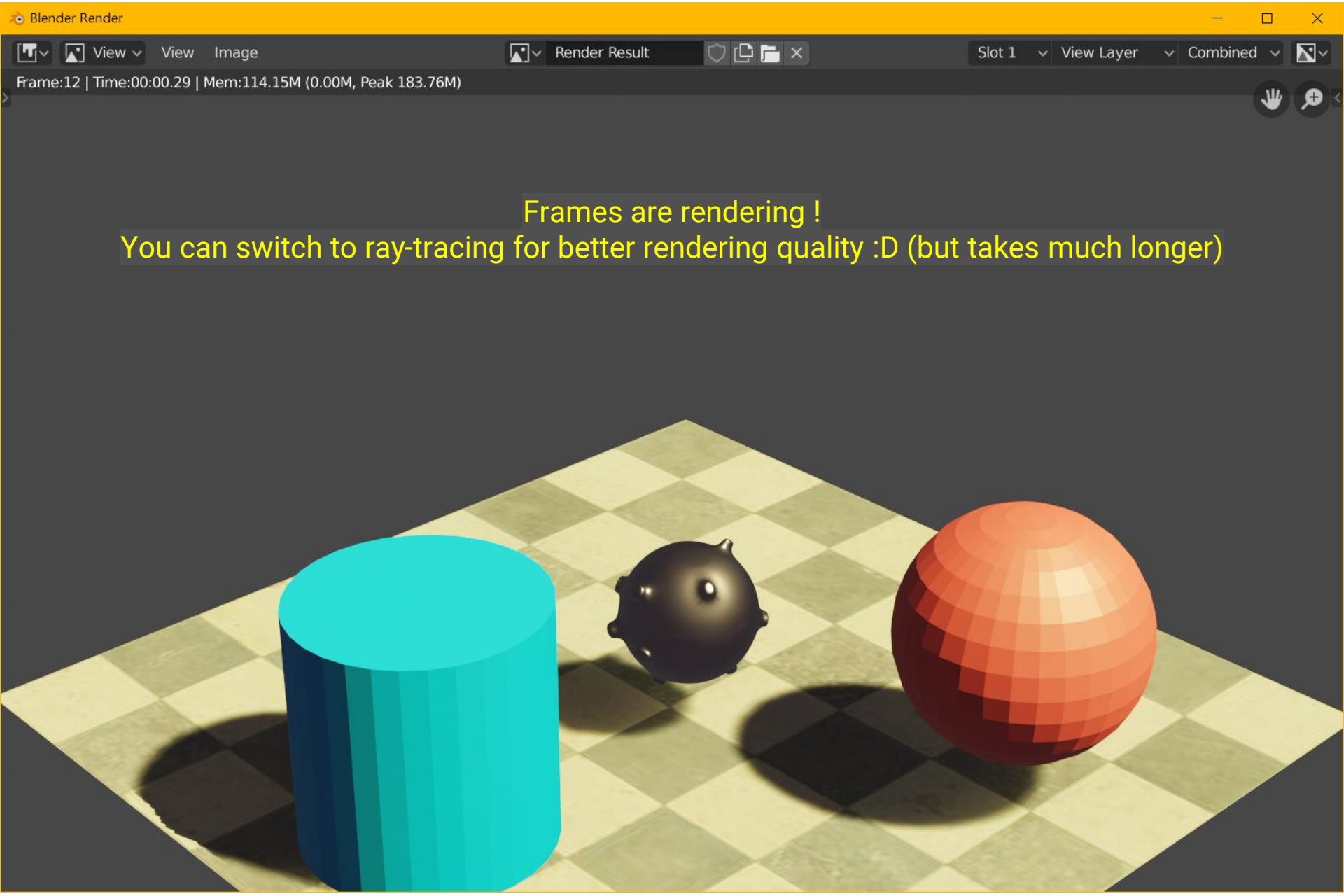
Output


Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Animation Rendering
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(0) Collection | Camera
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Properties
Output
Scene
Dimensions
Resolution X 1920 px
Y 1080 px
% 100%
Aspect X 1.000
Y 1.000
Render Region
Crop to Render Region
Frame Start 1
End 240
Step 1
Frame Rate 24 fps
Time Remapping
Stereoscopy
Output
/tmp\
Playback Keying View Marker
0
Start: 1
End: 240
0 50 100 150 200 250
Select
Center View to Mouse
Collection | Camera | Verts:5,289 | Faces:5,203


Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Animation Rendering
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(0) Collection | Camera
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Scene
Remember to change the output type to FFmpeg video
File Format
Image
BMP
Iris
PNG
JPEG
JPEG 2000
Targa
Targa Raw
Cineon
DPX
OpenEXR MultiLayer
TIFF
Movie
AVI JPEG
AVI Raw
FFmpeg video
The most versatile way to output video files.
Playback Keying View Marker
0
50
100
150
200
250
File Format PNG
Color BW RGB RGBA
Color Depth 8 16
Compression 15%
Metadata
Post Processing
Collection | Camera | Verts:5,289 | Faces:5,203


Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File Edit Render Window Help
Layout Animation Rendering
Scene
View Layer
Object Mode View Select Add Object
Global
User Perspective
(0) Collection | Camera
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Container
Flash
Matroska
And use MPEG-4 encoding
Overwrite
File Extensi..
Quicktime
AVI
MPEG-4
MPEG-2
MPEG-1
Encoding
Container
Matroska
Autosplit Output
Video
Video Codec
H.264
Output quality
Medium quality
Encoding speed
Good
Keyframe interval
18
Max B-fram..
Playback Keying View Marker
Start: 1
End: 240
Collection | Camera | Verts:5,289 | Faces:5,203


Blender* [C:\Users\kevin\OneDrive\桌面\gas\untitled.blend]
File
Edit
Render
Window
Help
Layout
Animation
Rendering
Scene
View Layer
Render Image F12
Render Animation Ctrl F12
Render Audio...
Render active scene.
View Render F11
View Animation Ctrl F11
Display Mode
Lock Interface
Now you can render the animation !
Global
Scene Collection
Collection
Camera
Cylinder
Light
Plane
Sphere
Sphere.001
Scene
/tmp\
Overwrite
Placeholders
File Extensi..
Cache Result
File Format
FFmpeg vi..
Color
BW
RGB
Encoding
Container
Matroska
Autosplit Output
Video
Video Codec
H.264
Output quality
Medium quality
Encoding speed
Good
Keyframe interval
18
Max B-fram..
0
Playback
Keying
View
Marker
Start: 1
End: 240
0
50
100
150
200
250
Select
Move
Rotate View
Object Context Menu
Collection | Camera | Verts:5,289 | Faces:5,203


Blender Render
View
View
Image
Render Result
Slot 1
View Layer
Combined
Frame:12 | Time:00:00.29 | Mem:114.15M (0.00M, Peak 183.76M)
Frames are rendering !
You can switch to ray-tracing for better rendering quality :D (but takes much longer)

Homework #2

- Create a **short animation** using blender
  - Find 3D models on the internet and load them in blender (20%)
  - Add animation of translation (20%)
  - Add animation of rotation (20%)
  - Add animation of scaling (20%)
  - A short one-page report for describing your work (10%)
  - Creativity and quality (10%)
- Personal work
- Due date: 5/29
- 15% for the final grading
- Hand in your *.blend file and the output *.mp4 video
  - 1920 x 1080, 24fps

Homework #2

- Where to download the 3D models?
  - Google is your best friend
  - Search “free 3D models”
  - Some example websites:
    - Free3D: https://free3d.com/3d-models/blender
    - CgTrader: https://www.cgtrader.com/free-3d-models
    - TurboSquid: https://www.turbosquid.com/Search/3D-Models/free
  - A collection: https://tw.eagle.cool/blog/post/best-websites-to-download-free-3d-model-with-high-quality
  - You can restrict the file types to *.blend, *.obj, *.fbx