

COL7655

Foundations of Visual Computing

Subodh Kumar

subodh@cse.iitd.ac.in

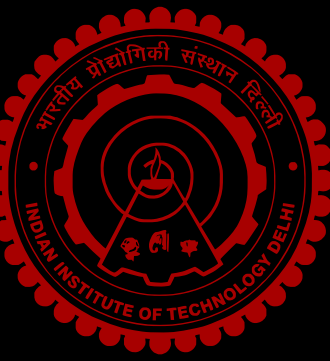
COL7655

Shapes and Models

Shape and its View

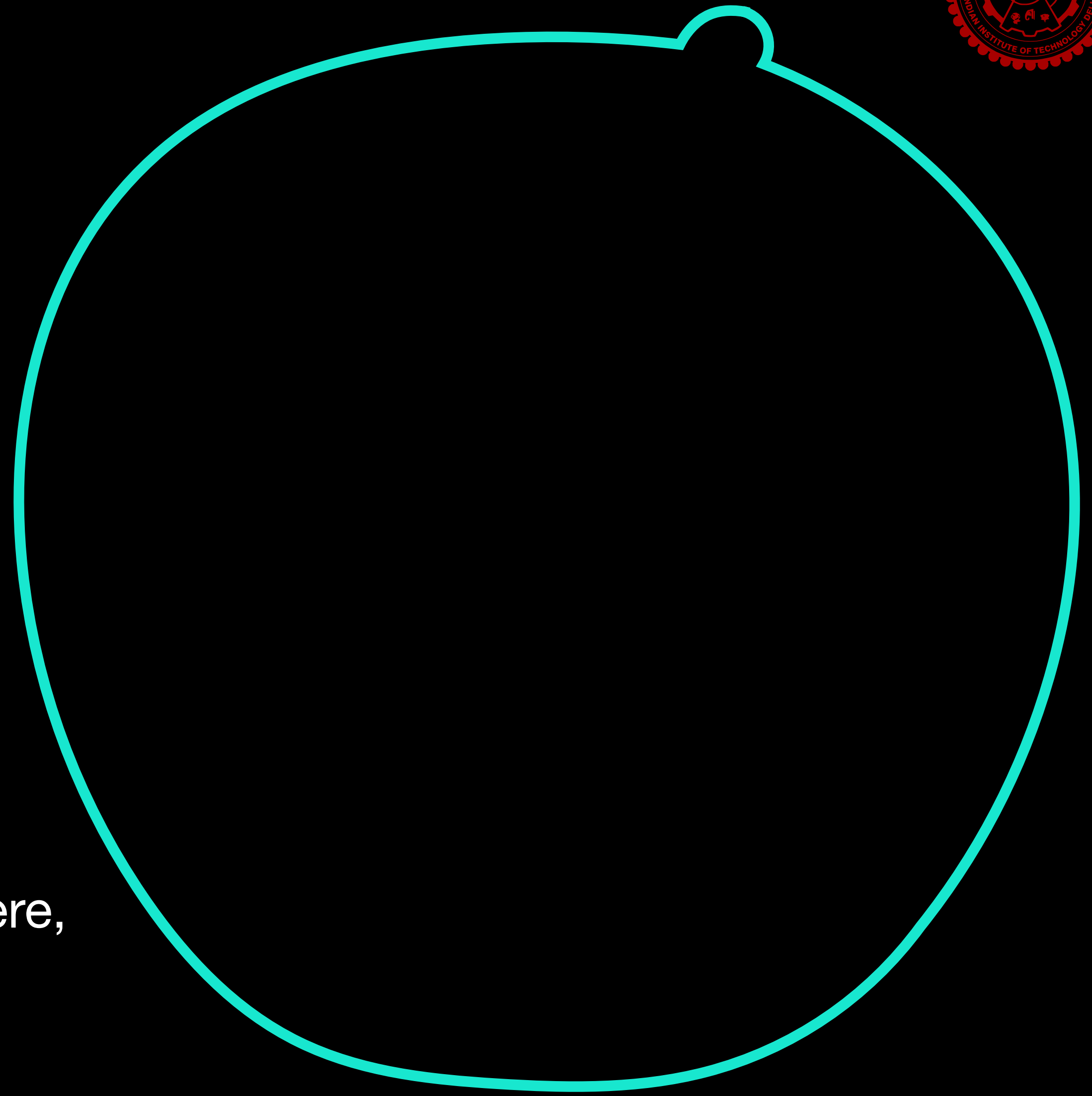
- *Shape* describes geometry
 - *Appearance* includes texture, reflectance, and illumination
 - In graphics, we embed appearance with the shape
- 3D shapes are embedded in 3D Euclidean space
 - Can be volume, surface, set of points/lines ..
 - Represented using points, lines, planes, cube, sphere, and more general equations
 - Smooth surfaces can be approximated by triangles
 - Triangle is a '2-simplex'





Shape and its View

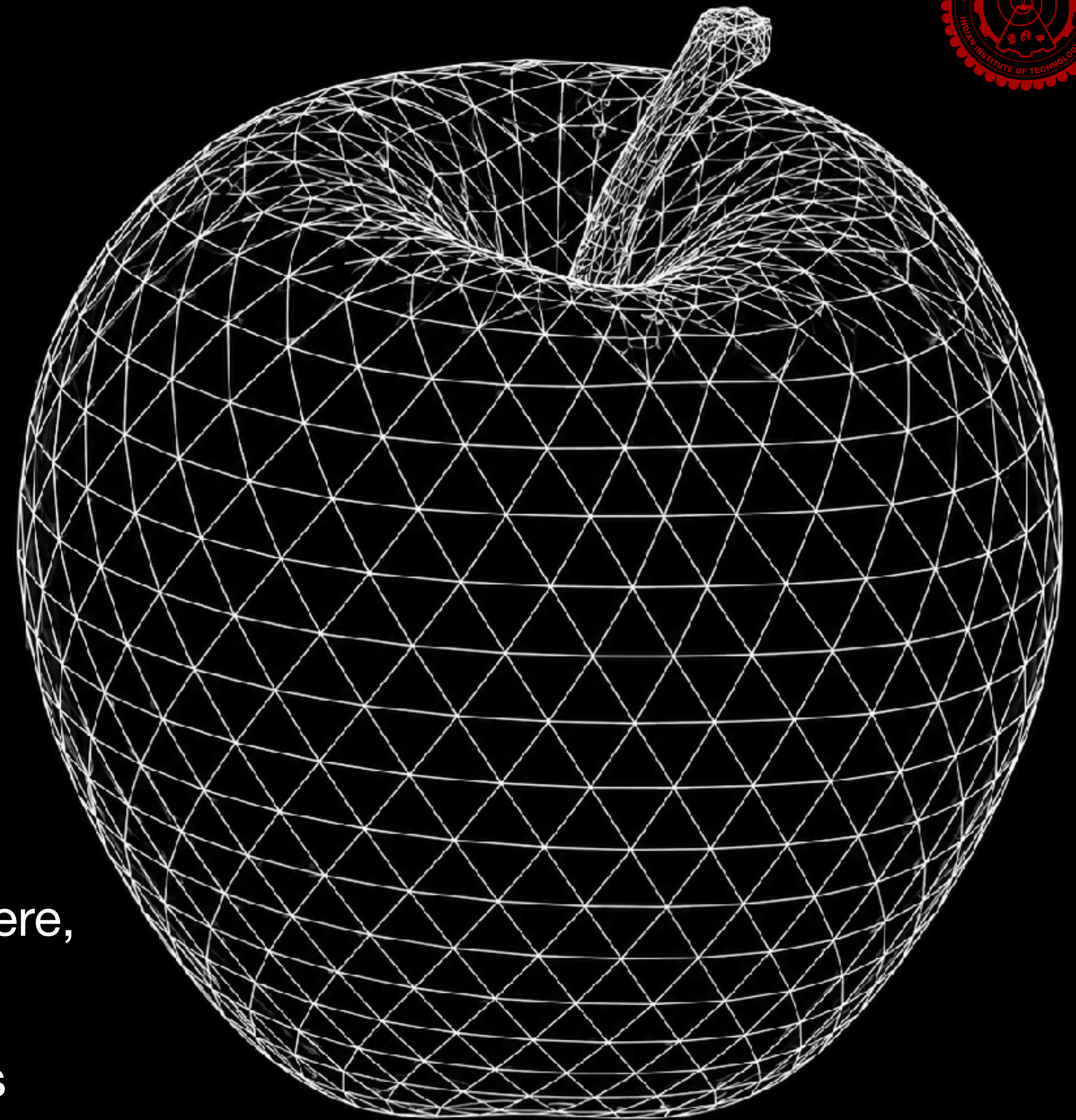
- *Shape* describes geometry
 - *Appearance* includes texture, reflectance, and illumination
 - In graphics, we embed appearance with the shape
- 3D shapes are embedded in 3D Euclidean space
 - Can be volume, surface, set of points/lines ..
 - Represented using points, lines, planes, cube, sphere, and more general equations
 - Smooth surfaces can be approximated by triangles
 - Triangle is a '2-simplex'



Shape and its View

Occlusion

- *Shape* describes geometry
 - *Appearance* includes texture, reflectance, and illumination
 - In graphics, we embed appearance with the shape
- 3D shapes are embedded in 3D Euclidean space
 - Can be volume, surface, set of points/lines ..
 - Represented using points, lines, planes, cube, sphere, and more general equations
 - Smooth surfaces can be approximated by triangles
 - Triangle is a '2-simplex'



Shape and its View

Occlusion

-

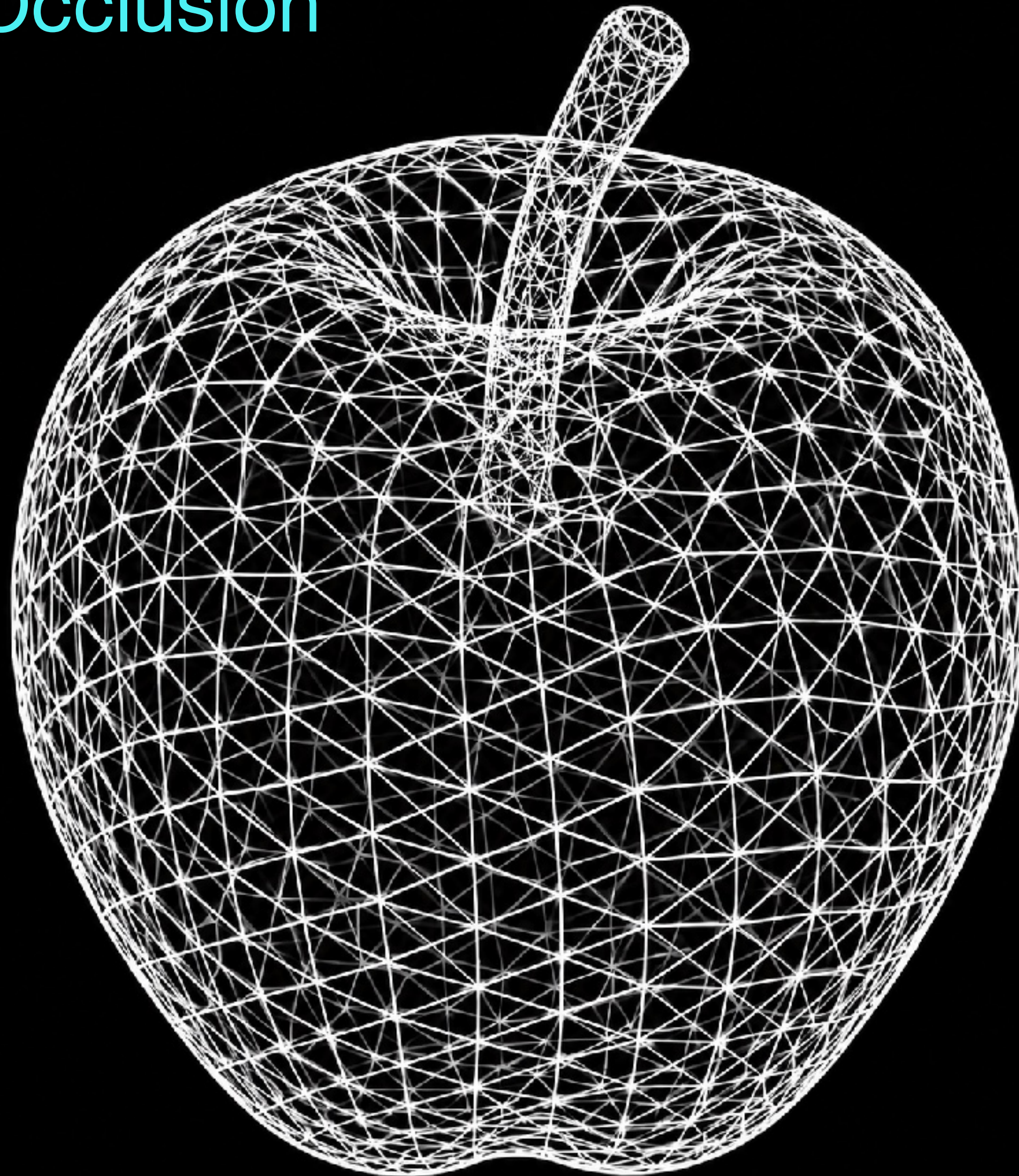
-

-

-

-

-

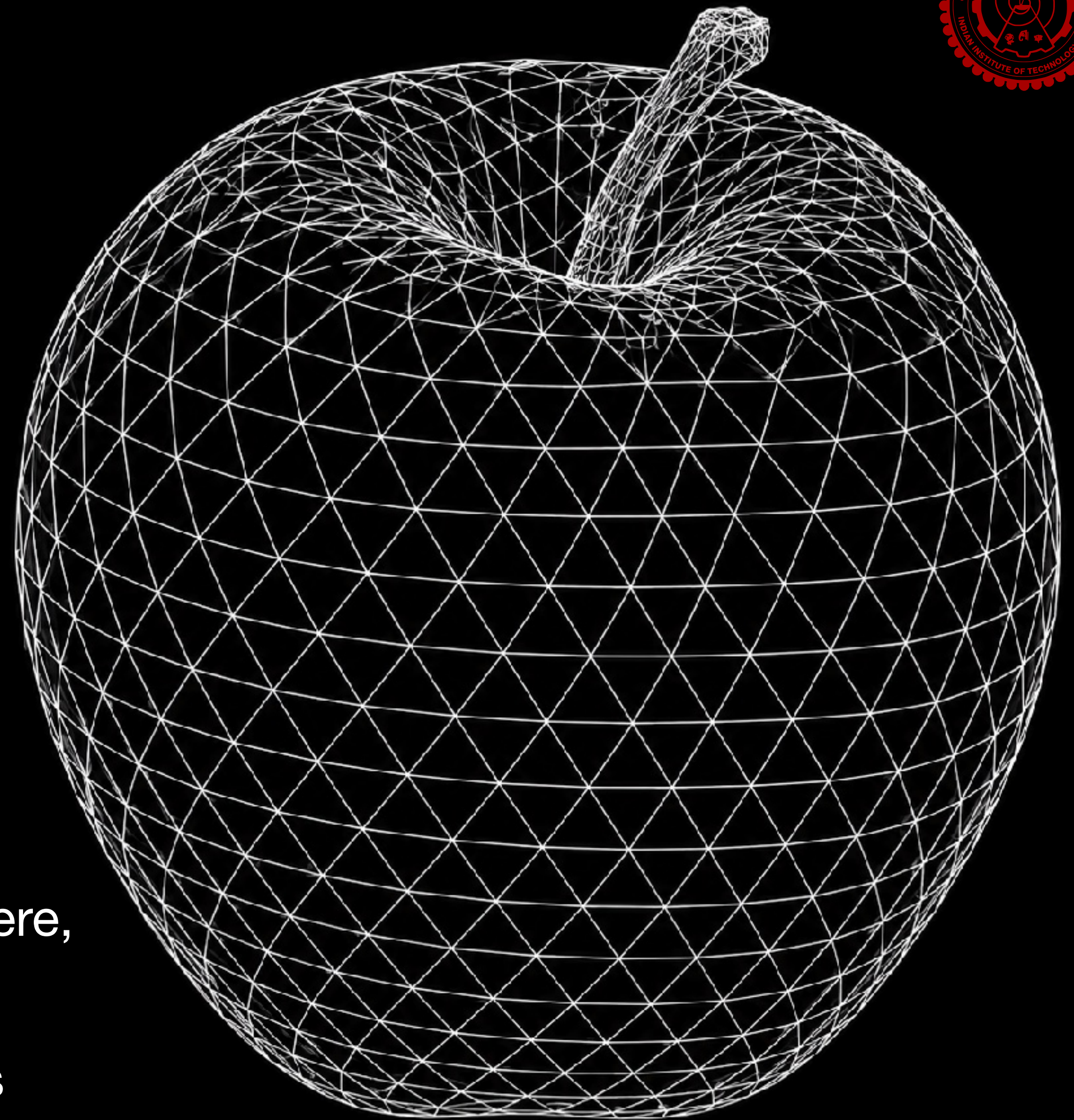


is

is

here,

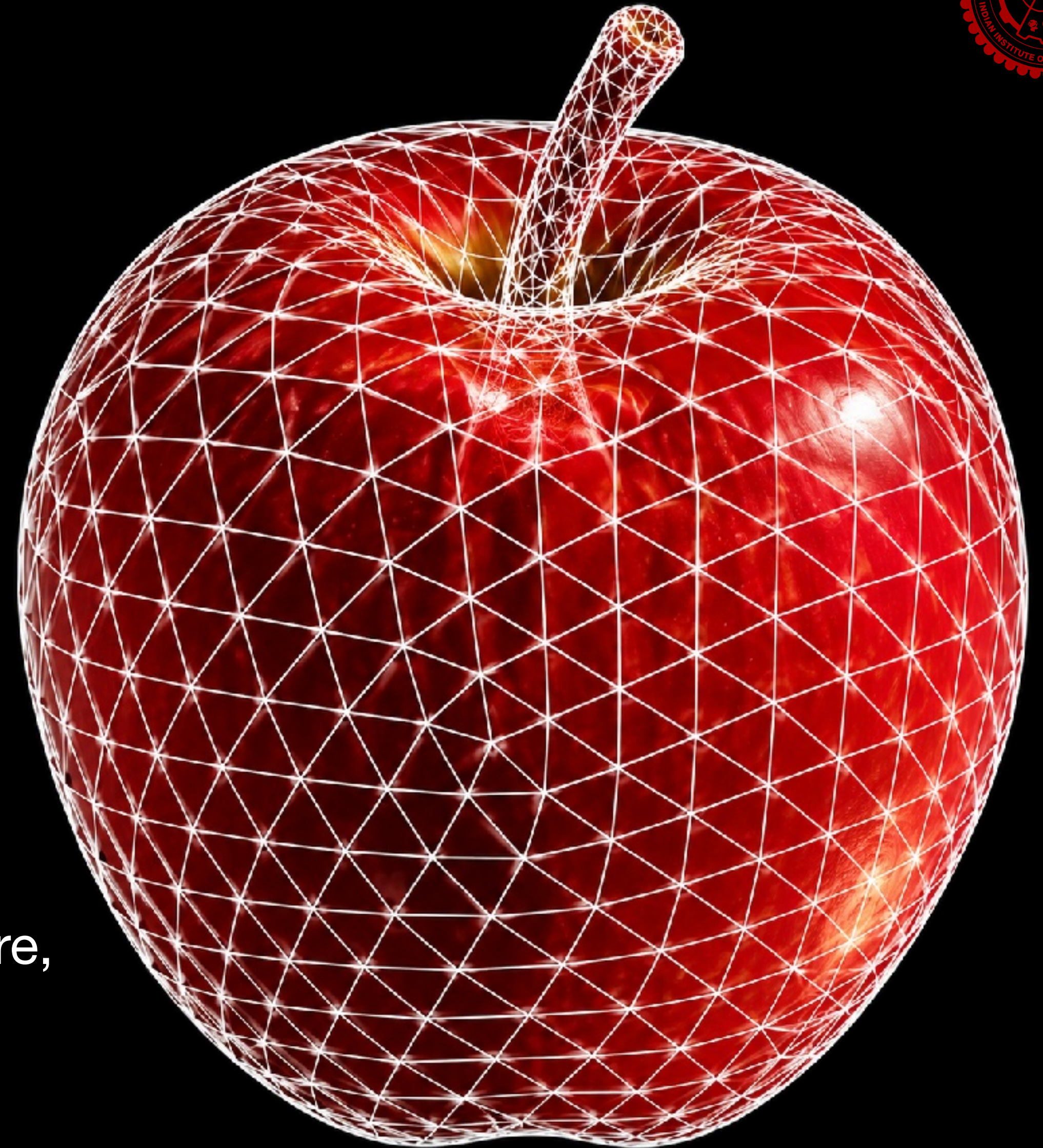
is



Shape and its View

Color and appearance

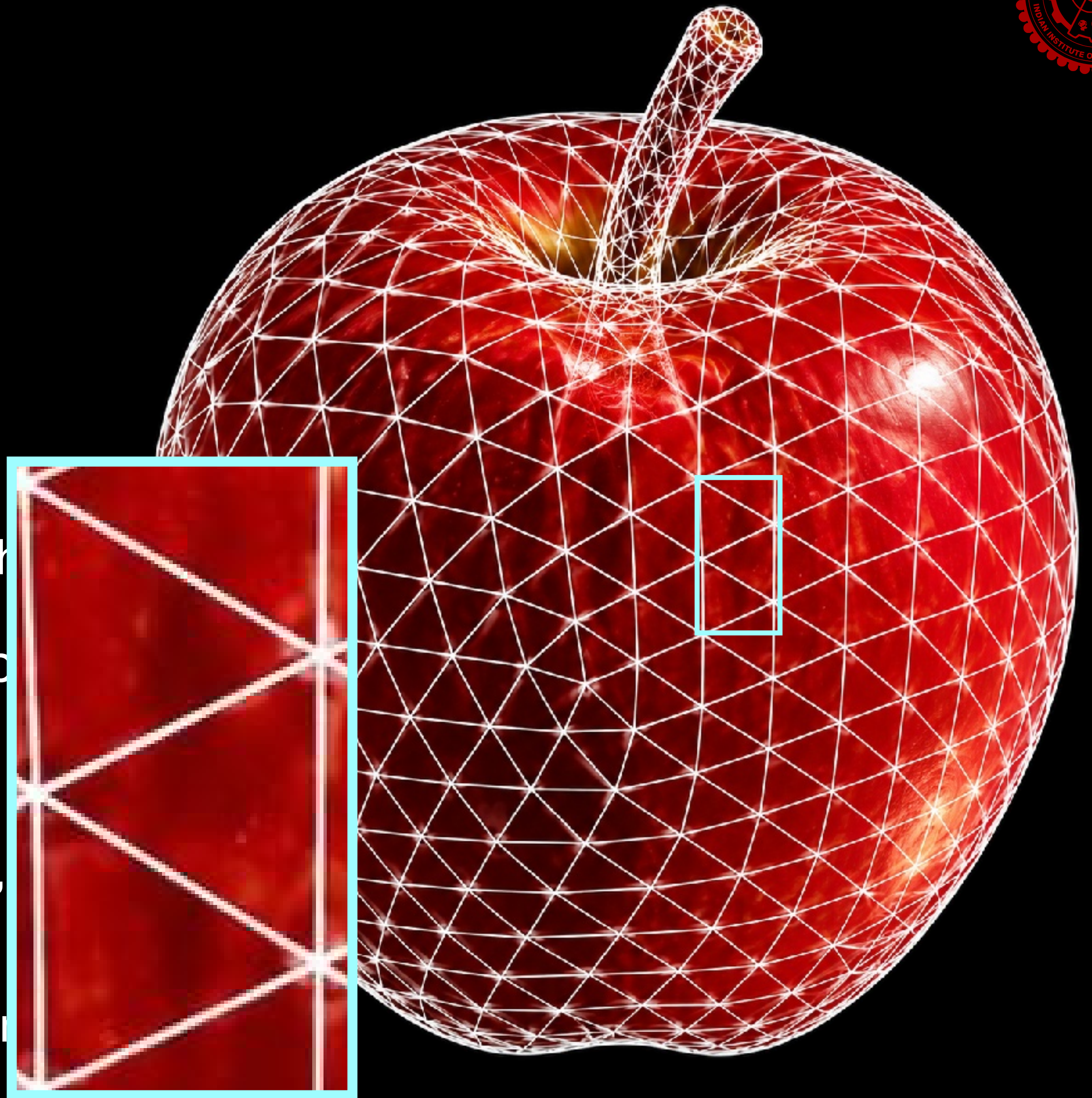
- *Shape* describes geometry
 - *Appearance* includes texture, reflectance, and illumination
 - In graphics, we embed appearance with the shape
- 3D shapes are embedded in 3D Euclidean space
 - Can be volume, surface, set of points/lines ..
 - Represented using points, lines, planes, cube, sphere, and more general equations
 - Smooth surfaces can be approximated by triangles
 - Triangle is a '2-simplex'



Shape and its View

Color and appearance

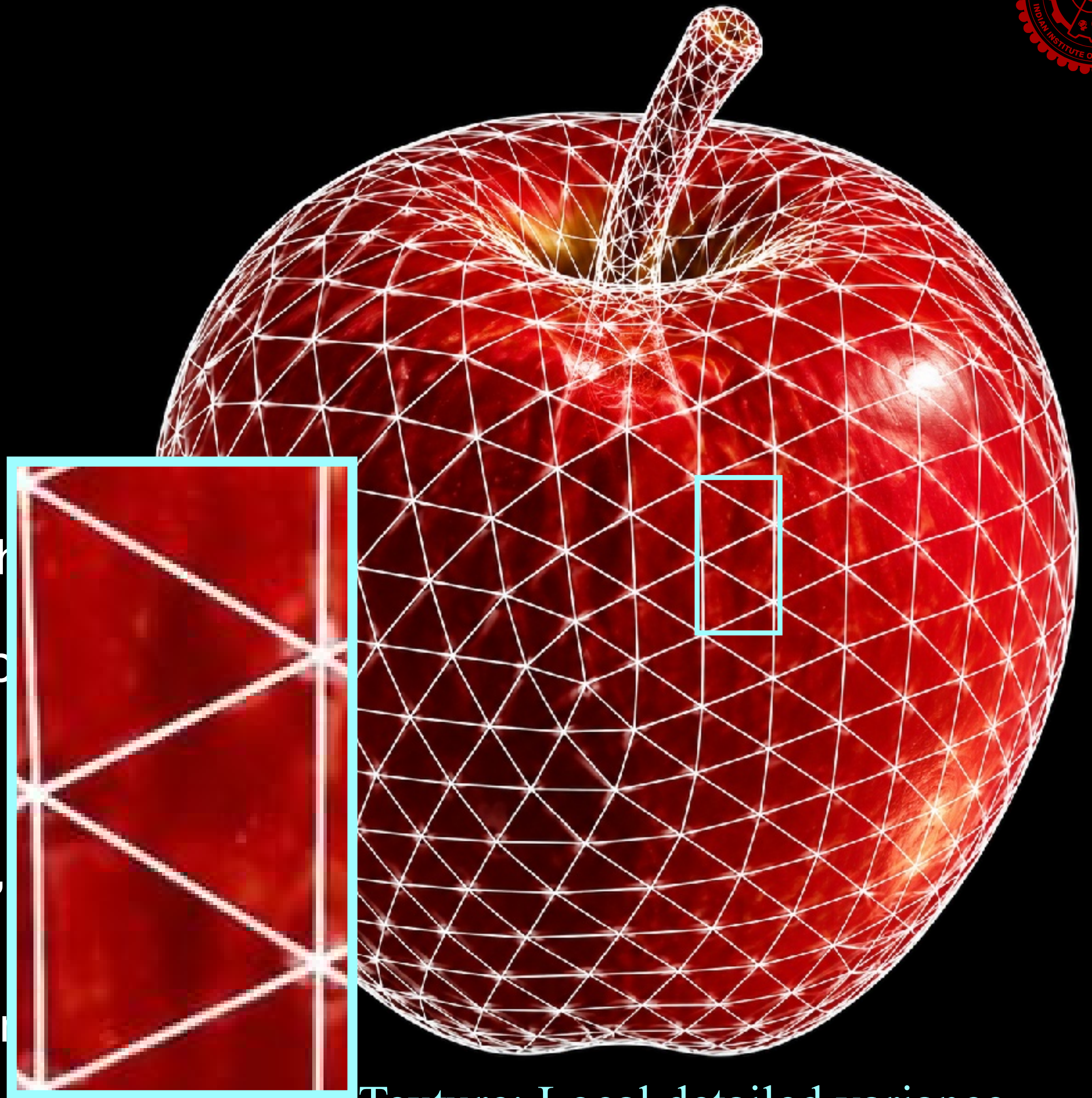
- *Shape* describes geometry
 - *Appearance* includes texture, reflectance, and illumination
 - In graphics, we embed appearance with the shape
- 3D shapes are embedded in 3D Euclidean space
 - Can be volume, surface, set of points/lines ..
 - Represented using points, lines, planes, cube, and more general equations
 - Smooth surfaces can be approximated by triangles
 - Triangle is a '2-simplex'



Shape and its View

Color and appearance

- *Shape* describes geometry
 - *Appearance* includes texture, reflectance, and illumination
 - In graphics, we embed appearance with the shape
- 3D shapes are embedded in 3D Euclidean space
 - Can be volume, surface, set of points/lines ..
 - Represented using points, lines, planes, cube, and more general equations
 - Smooth surfaces can be approximated by triangles
 - Triangle is a '2-simplex'

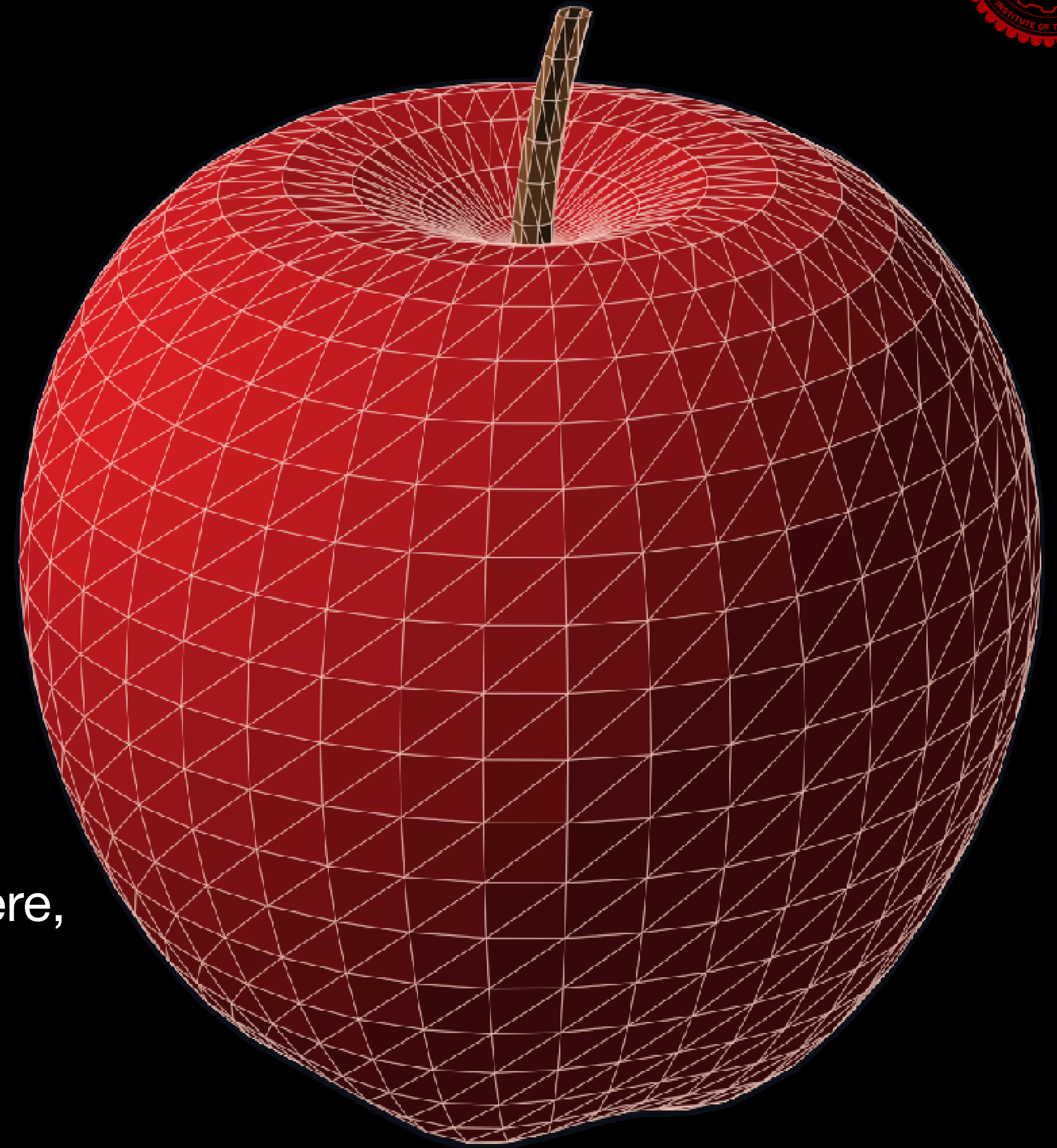


Texture: Local detailed variance

Shape and its View

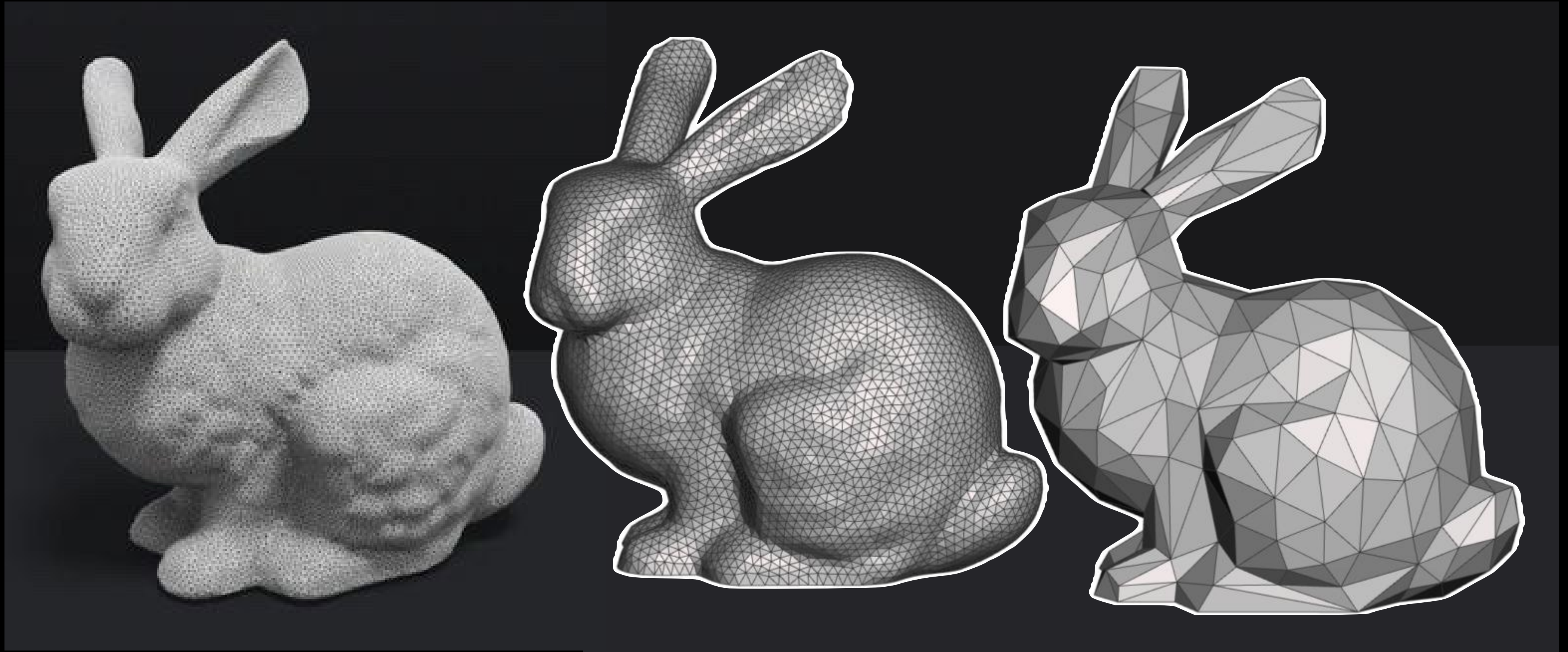
Linearly varying color

- *Shape* describes geometry
 - *Appearance* includes texture, reflectance, and illumination
 - In graphics, we embed appearance with the shape
- 3D shapes are embedded in 3D Euclidean space
 - Can be volume, surface, set of points/lines ..
 - Represented using points, lines, planes, cube, sphere, and more general equations
 - Smooth surfaces can be approximated by triangles
 - Triangle is a '2-simplex'



Making Appearances

Textures can control appearance, but not shape



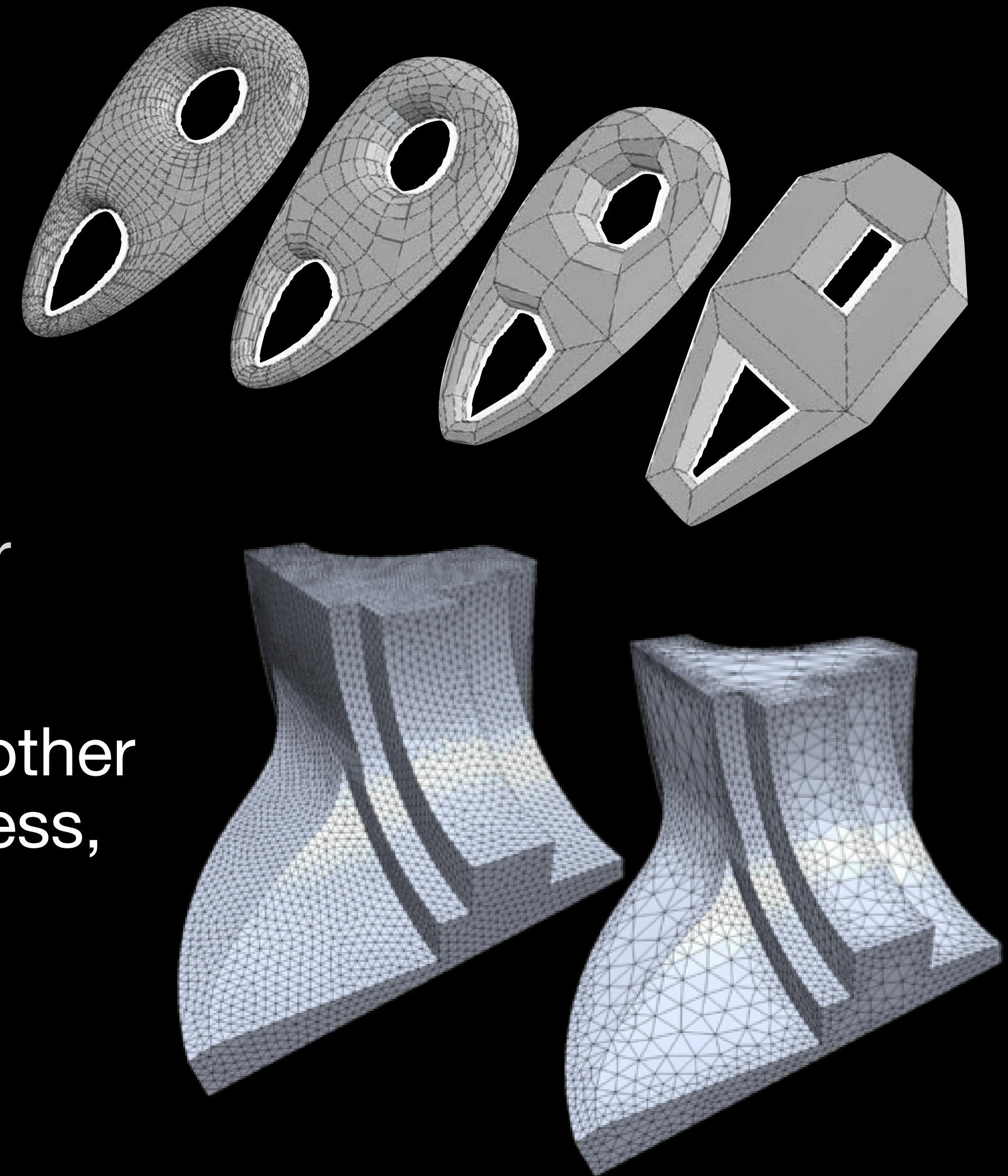
Making Appearances

Textures can control appearance, but not shape



Triangle (Polygon) Meshes

- Triangles are the simplest shapes in 3D: Linear elements, efficient to transform and render
- Closeness of triangles to curved surfaces can be controlled by using fewer or more triangles
 - Sometimes, we use quadrilaterals or other planar polygonal shapes
- Vertices, Edge or Triangle may carry information other than their position (e.g., color, reflectivity, roughness, texture coordinate ..)



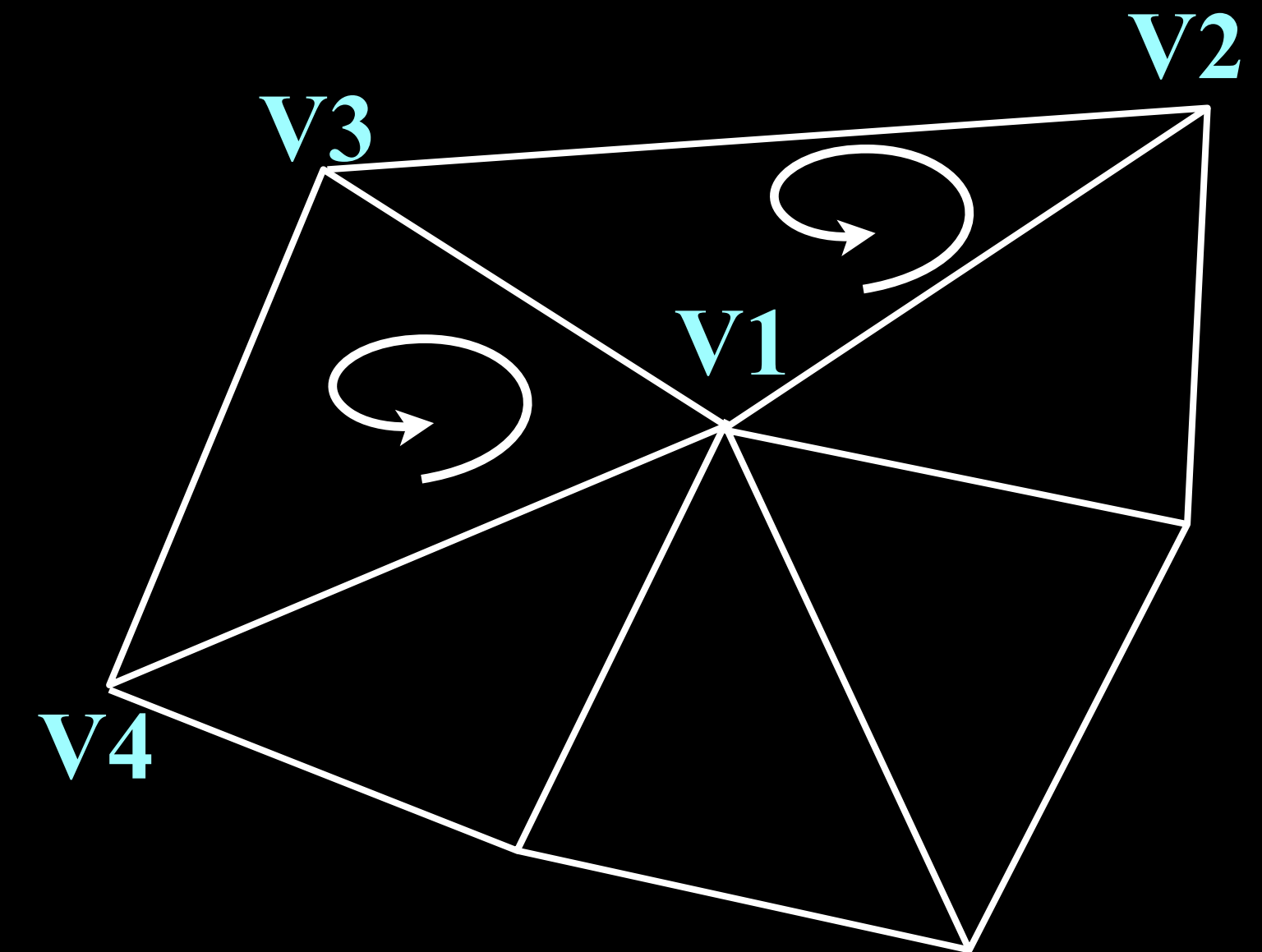
Triangle Representation

Using coordinate geometry (Model Space)

- Polygon soup
 - Redundant storage of vertices (geometry)
 - No connectivity information (topology is implicit)
- Find neighbor? Adjacency?

```
V1_x V1_y V1_z V2_x V2_y V2_z V3_x V3_y V3_z
V1_x V1_y V1_z V3_x V3_y V3_z V4_x V4_y V4_z
...
```

Does the order of vertices matter?



```
V1_x V1_y V1_z n1_x n1_y n1_z V2_x V2_y V2_z n2_x n2_y n2_z V3_x V3_y V3_z n3_x n3_y n3_z
V1_x V1_y V1_z n1_x n1_y n1_z V3_x V3_y V3_z n3_x n3_y n3_z V4_x V4_y V4_z n4_x n4_y n4_z
...
```

Vertices have attributes other than position: e.g., normal, texture coordinates, ...

Triangle Representation

Using coordinate geometry (Model Space)

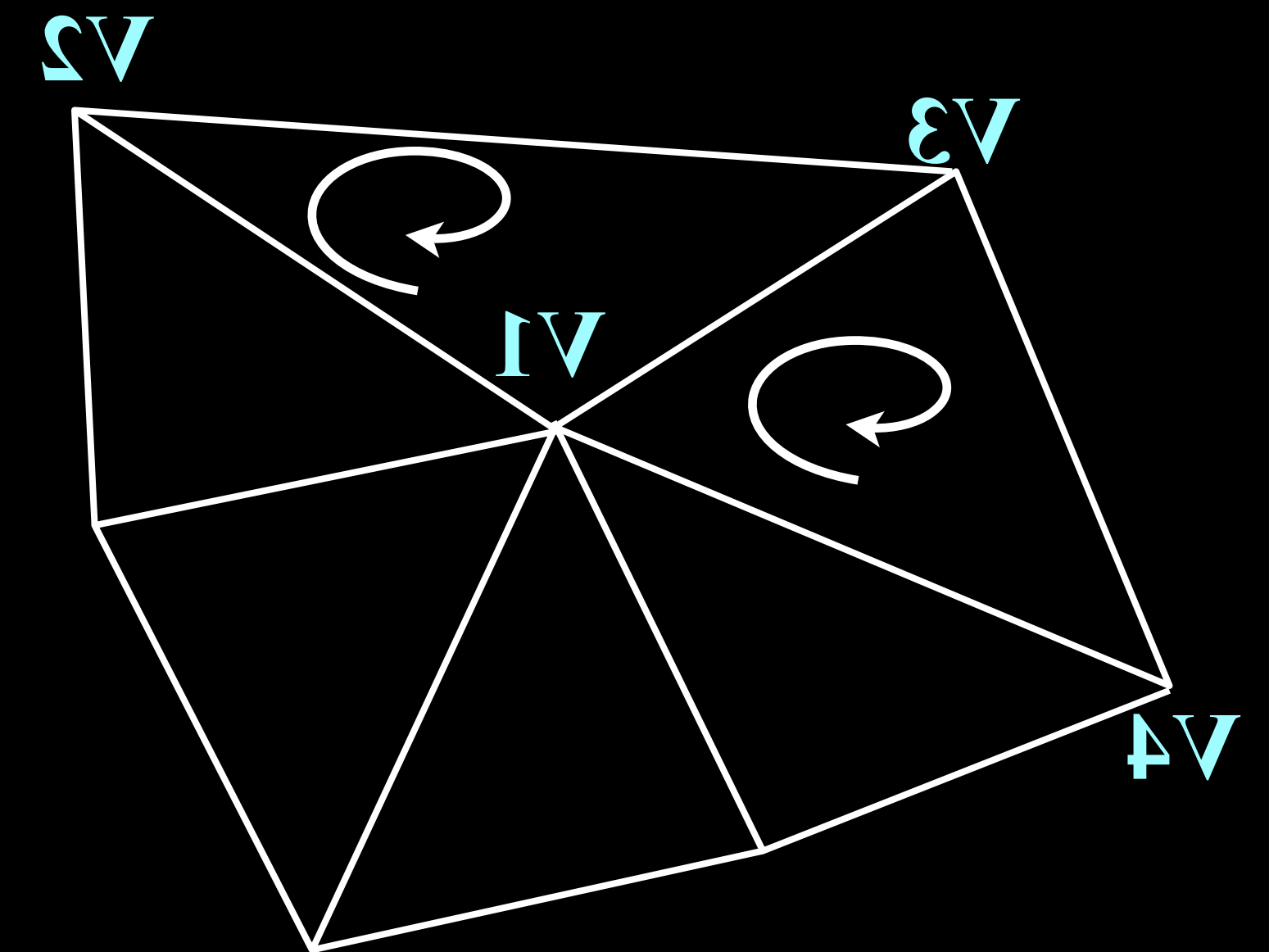
In 3D, Triangles have two sides

- Polygon soup
 - Redundant storage of vertices (geometry)
 - No connectivity information (topology is implicit)

Find neighbor? Adjacency?

$V1_x V1_y V1_z V2_x V2_y V2_z V3_x V3_y V3_z$
 $V1_x V1_y V1_z V3_x V3_y V3_z V4_x V4_y V4_z$
 ...

Does the order of vertices matter?



$V1_x V1_y V1_z n1_x n1_y n1_z V2_x V2_y V2_z n2_x n2_y n2_z V3_x V3_y V3_z n3_x n3_y n3_z$
 $V1_x V1_y V1_z n1_x n1_y n1_z V3_x V3_y V3_z n3_x n3_y n3_z V4_x V4_y V4_z n4_x n4_y n4_z$
 ...

Vertices have attributes other than position: e.g., normal, texture coordinates, ...