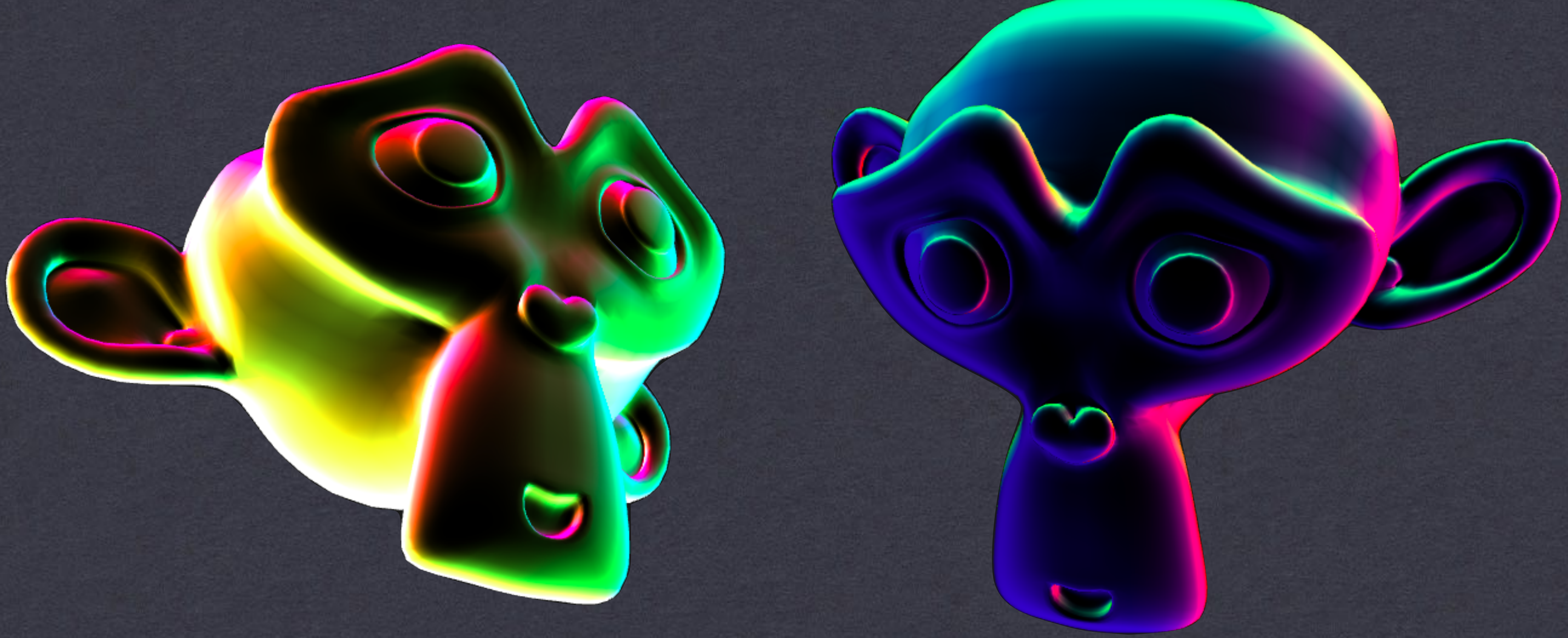


INTRODUCTION TO 3D GRAPHICS

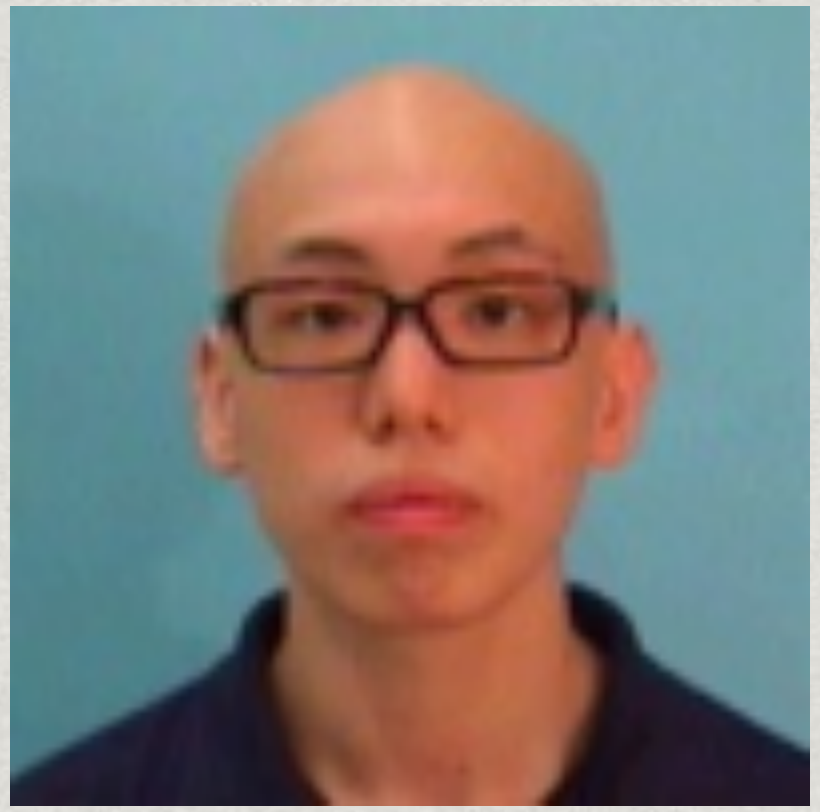
MUSL2361 - VR ADVENTURE

香 港 資 優 教 育 學 苑
The Hong Kong Academy for Gifted Education

Teaching Crew

Dr. Martin Choy

Mr. Kenny Cheng



Stephen

Cyrus

and more…

Tentative Teaching Schedule

Aug 20	Getting Started with Three.js		**Aug 27**	Shader Programming
Aug 22	Lighting and Shading		**Aug 29**	Virtual Reality
Aug 24	Texture Mapping		**Aug 31**	Project Demo and Final Assessment

Expectation

- The course duration is **quite tight**, honestly.
- Probably you only got **one week** for the project development.
- This limits the complexity and scale of your product.
- Try to incorporate the skills learnt and produce some **innovative prototypes**.

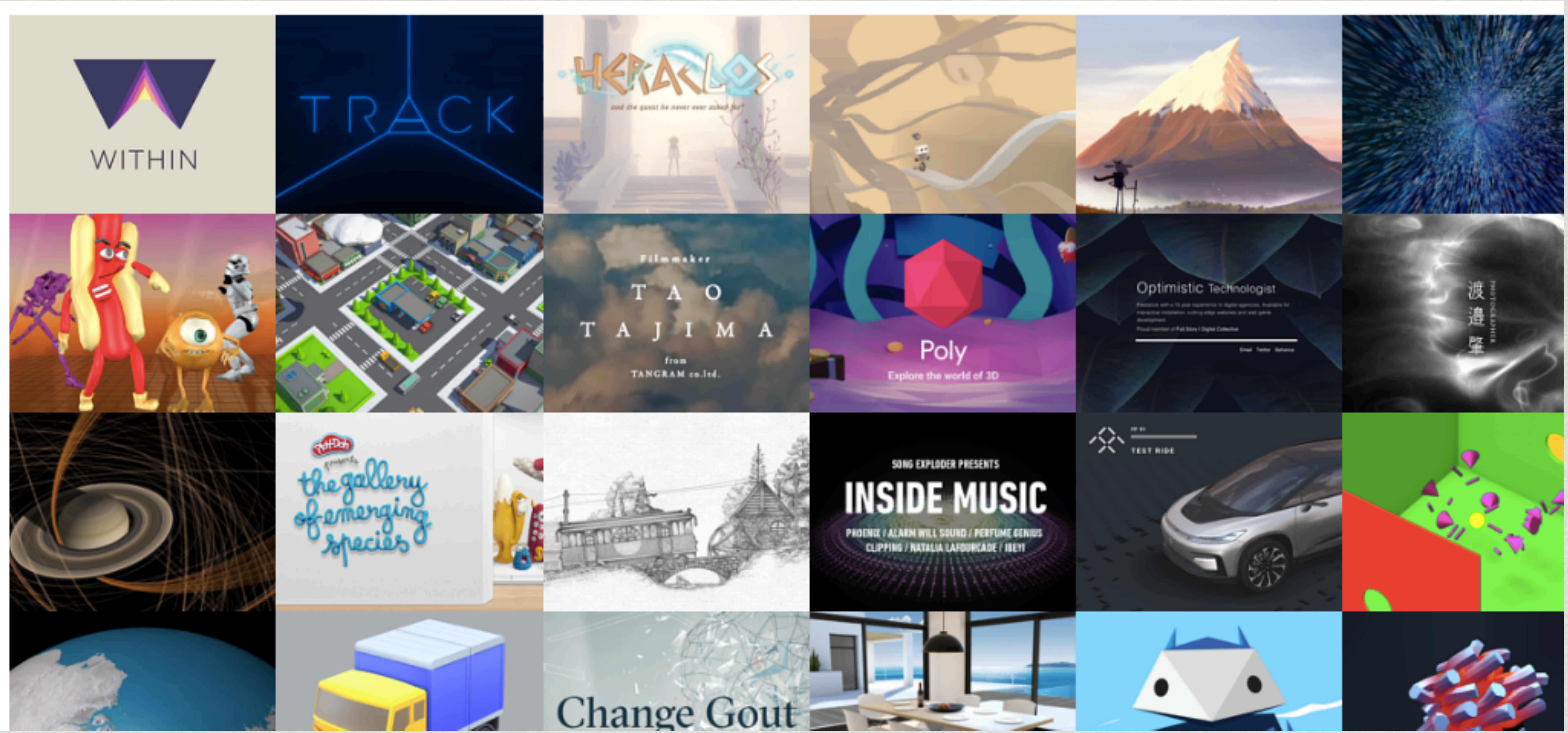
Building 3D Application

- There are **many options** in the market
  - Unity or Unity3D
  - Unreal Engine
  - **Three.js**
    - Open Source, lightweight, better web integration…

Three.js

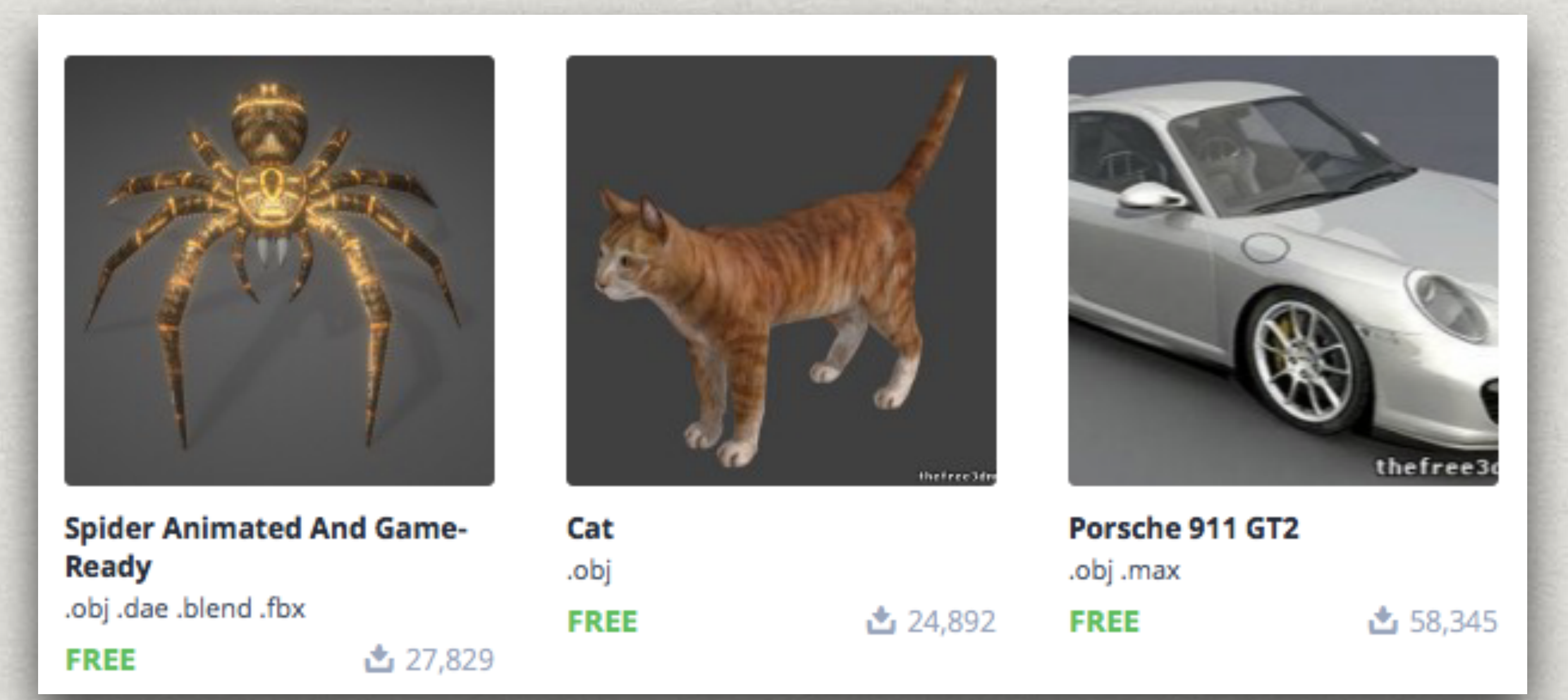
- **Three.JS** is a cross-browser **JavaScript** library/API which is used to create and animate **3D computer graphics** to display in a web browser.
- It includes features like effects, scenes, cameras, lights, sky, materials, meshes, shaders, animations, and 3D objects.
- Three.js uses **WebGL** which is JavaScript API used for rendering interactive 3D and 2D graphics in web browsers **without using any plugins**.

Let’s check out some demos



https://threejs.org

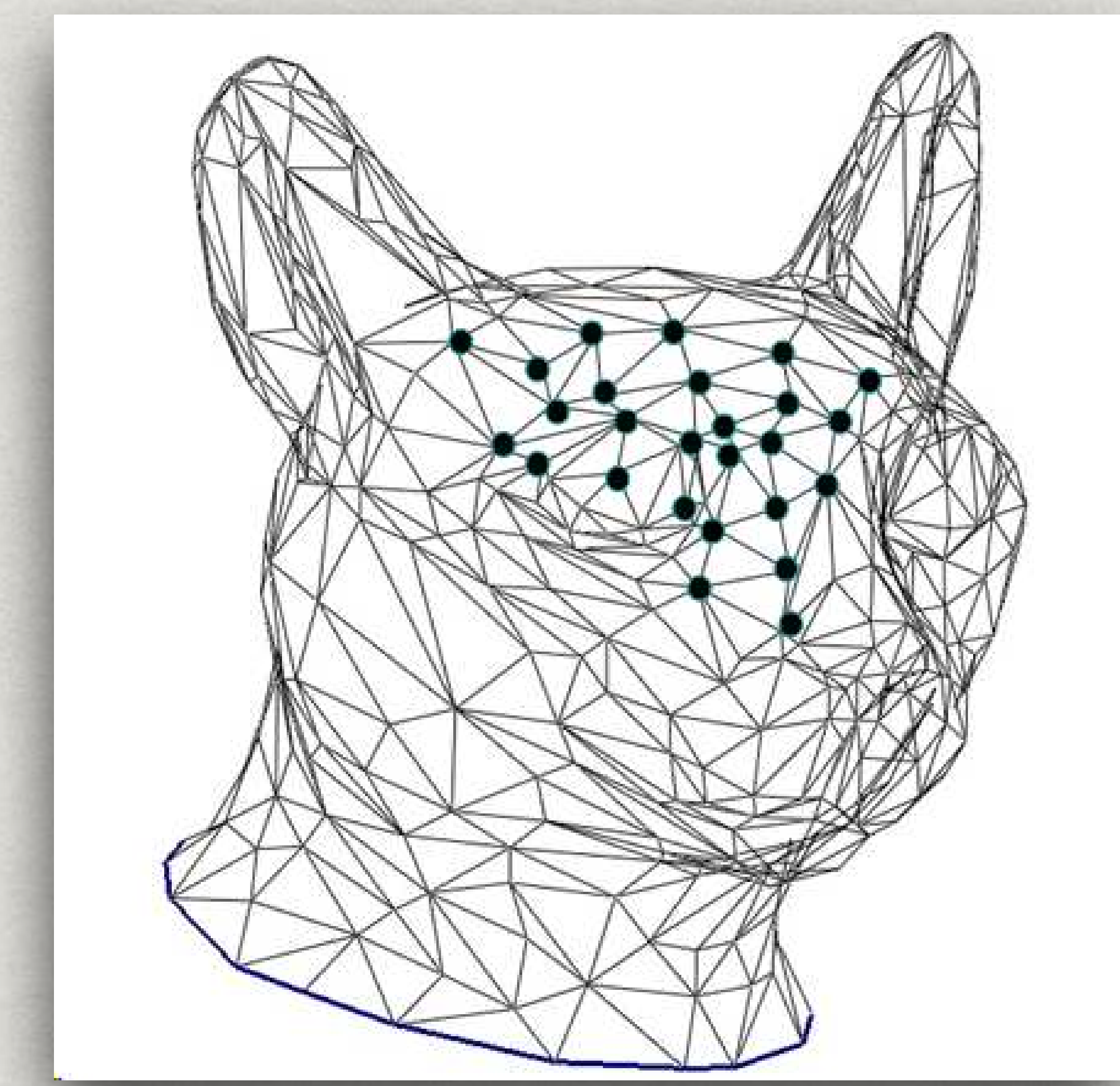
3D Objects



- You saw many 3D objects in the demos.
- Simple geometry (block, sphere) could be directly constructed with Three.js.
- More **complicated object models** could be developed with software like **Maya**, **3ds Max**, Blender or Google SketchUp.
- You can find **many free models** on the web, e.g., https://free3d.com

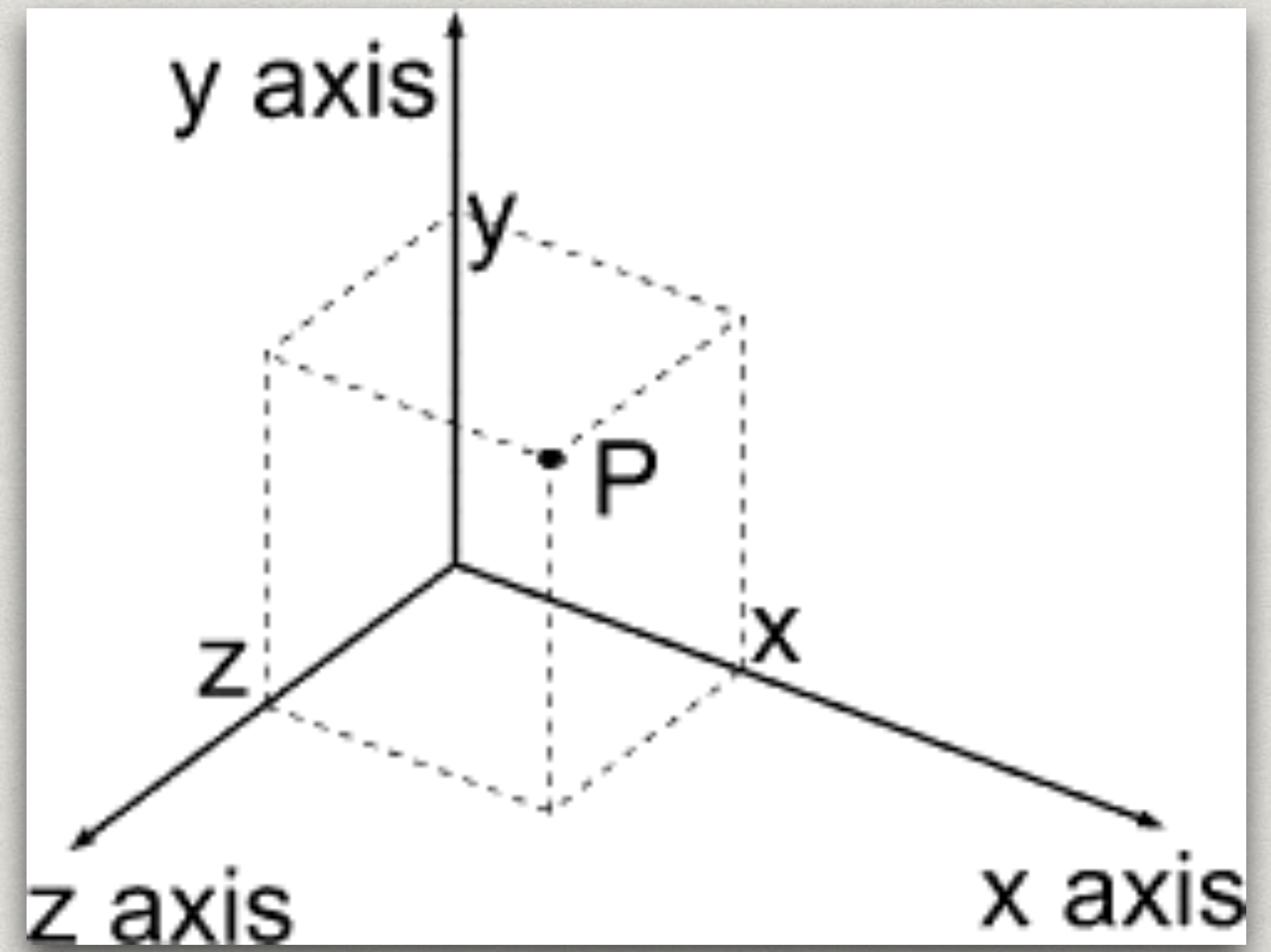
What's in a model?

* Basic representation of object starts with a **collection of triangles**
* Each triangle is formed by three vertices.
* Each vertex, obviously carries the **(x, y, z) position values**.
* May carry other **vertex attributes** including color, normal vector and material information.



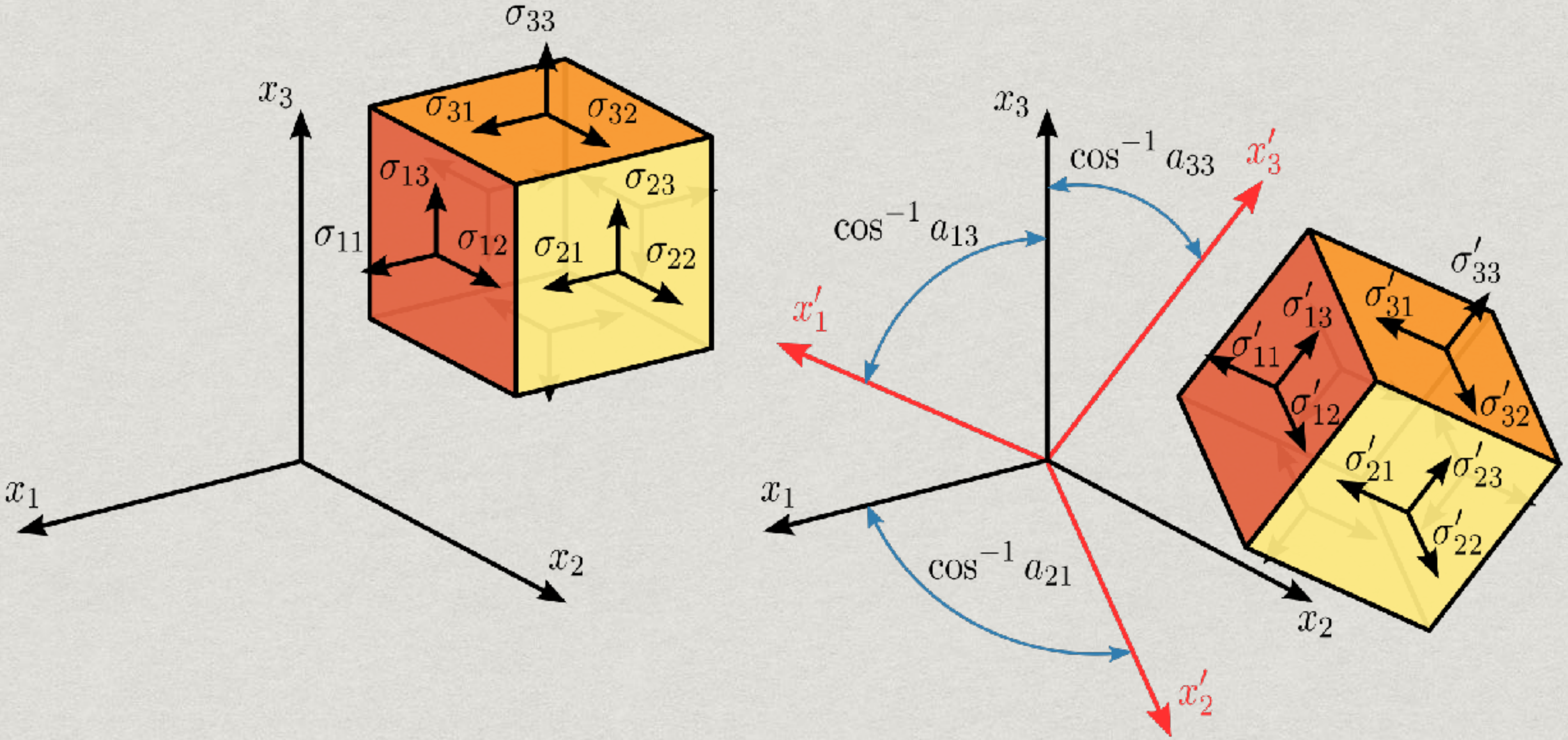
3D Coordinates

- Same (x, y) coordinate system as Cartesian.
- **Positive z points towards you**.



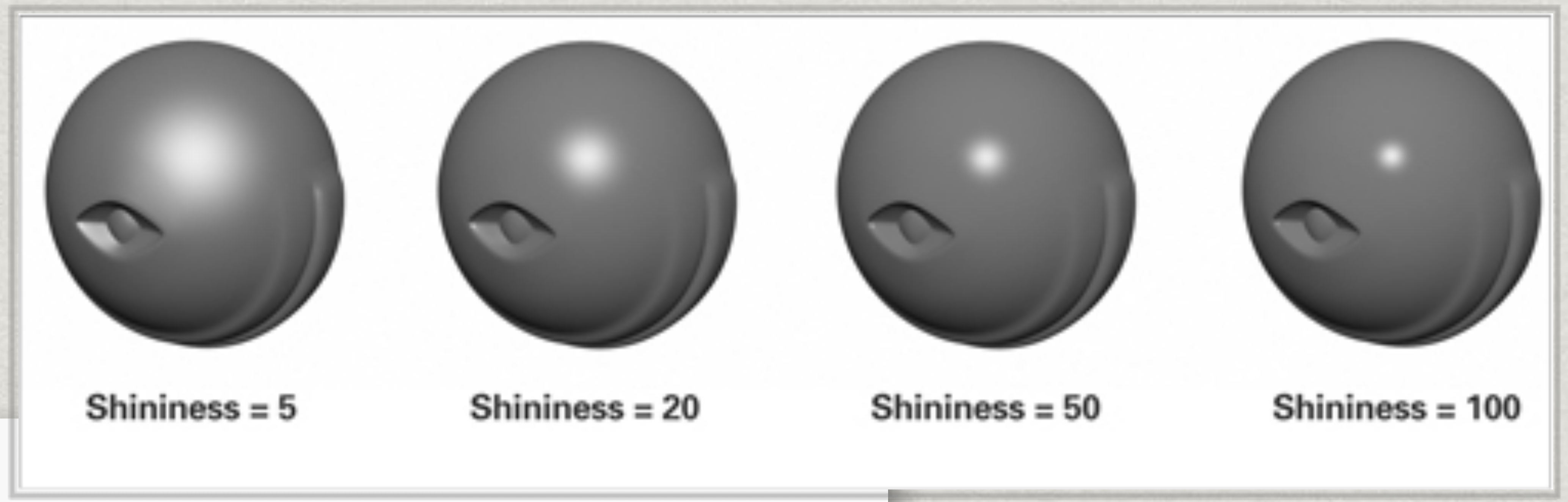
Object Transformation

- Translation
- Rotation
- Scaling
  - Reflection



http://davidscottlyons.com/threejs-intro/#slide-19

Materials



Shininess

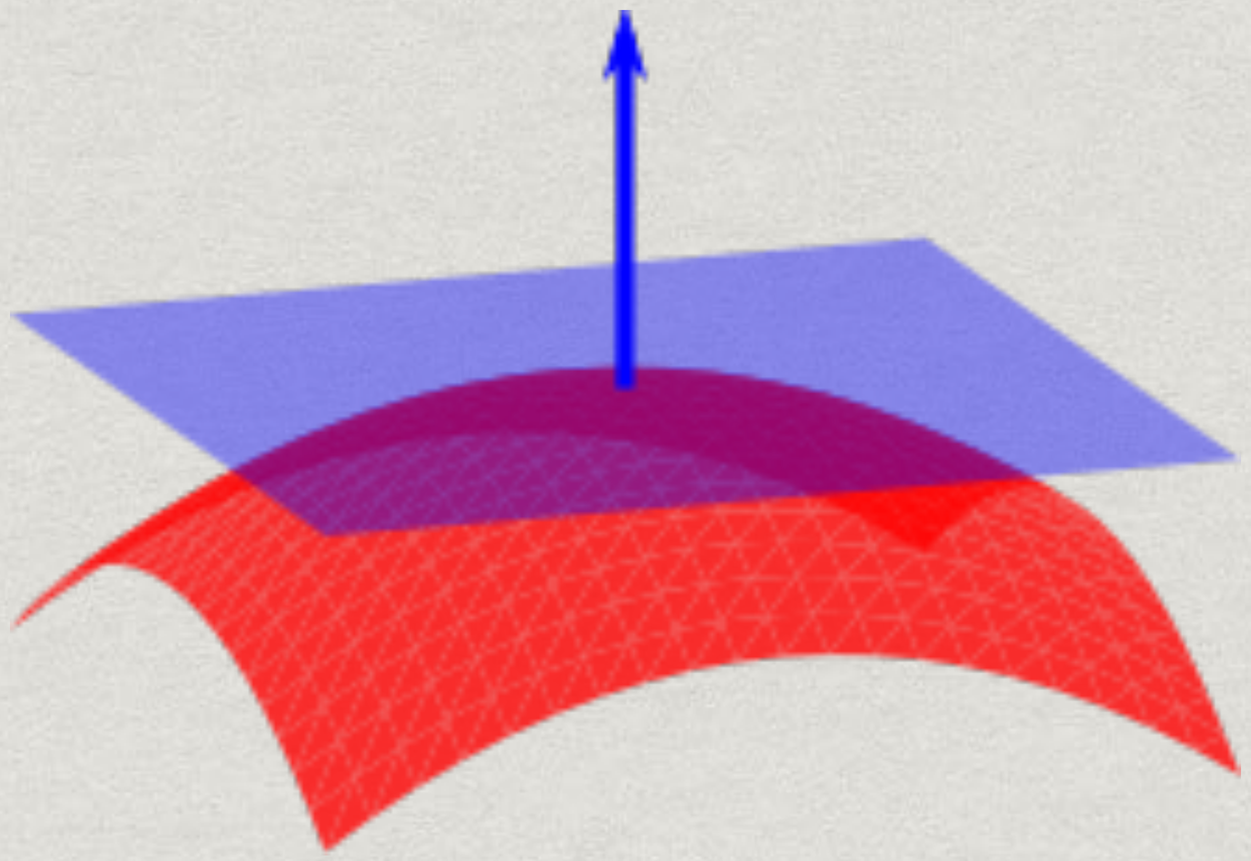
Basic
light-independent

Lambert
Non-shinny objects
like wood, paper

Phong
Shinny objects
like metal and plastic

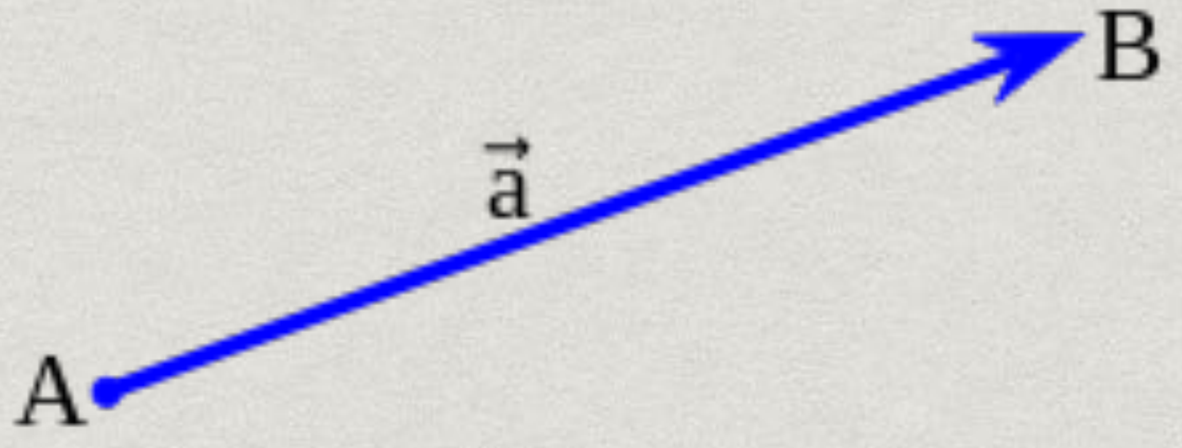
Normal Material?

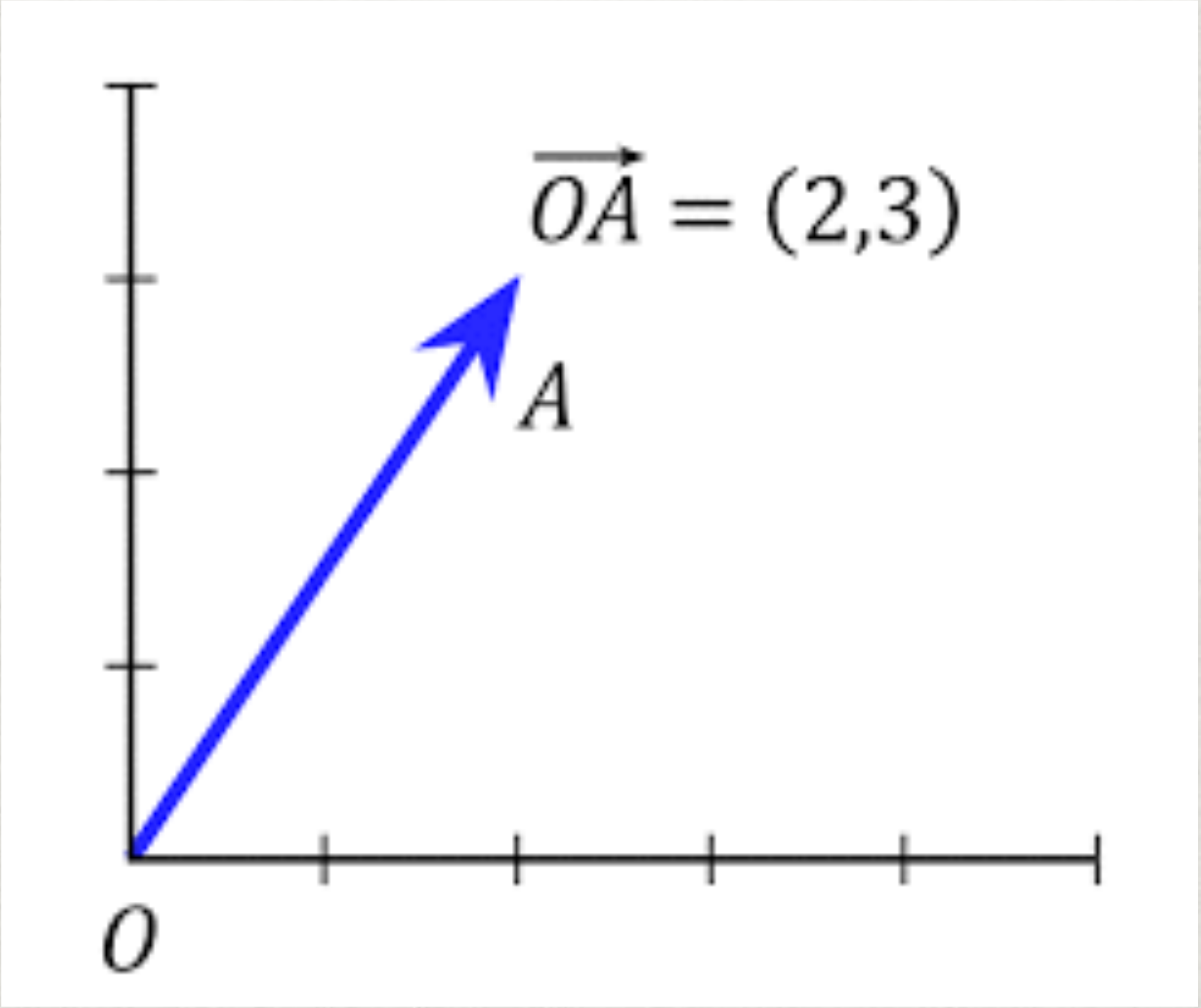
- Why **normal material** looks so abnormal?
- In geometry, **normal** refers to the **vector** (or simply **direction**) which is **perpendicular** to a surface.



Vector

- In mathematics, physics, and engineering, a **vector** is a geometric object that has **magnitude** (or length) and **direction**.
- A vector is what is needed to "carry" the point A to the point B.
- For example, in the 2D space as shown in the figure, the vector which “carries” **point O to point A is (2, 3)**.

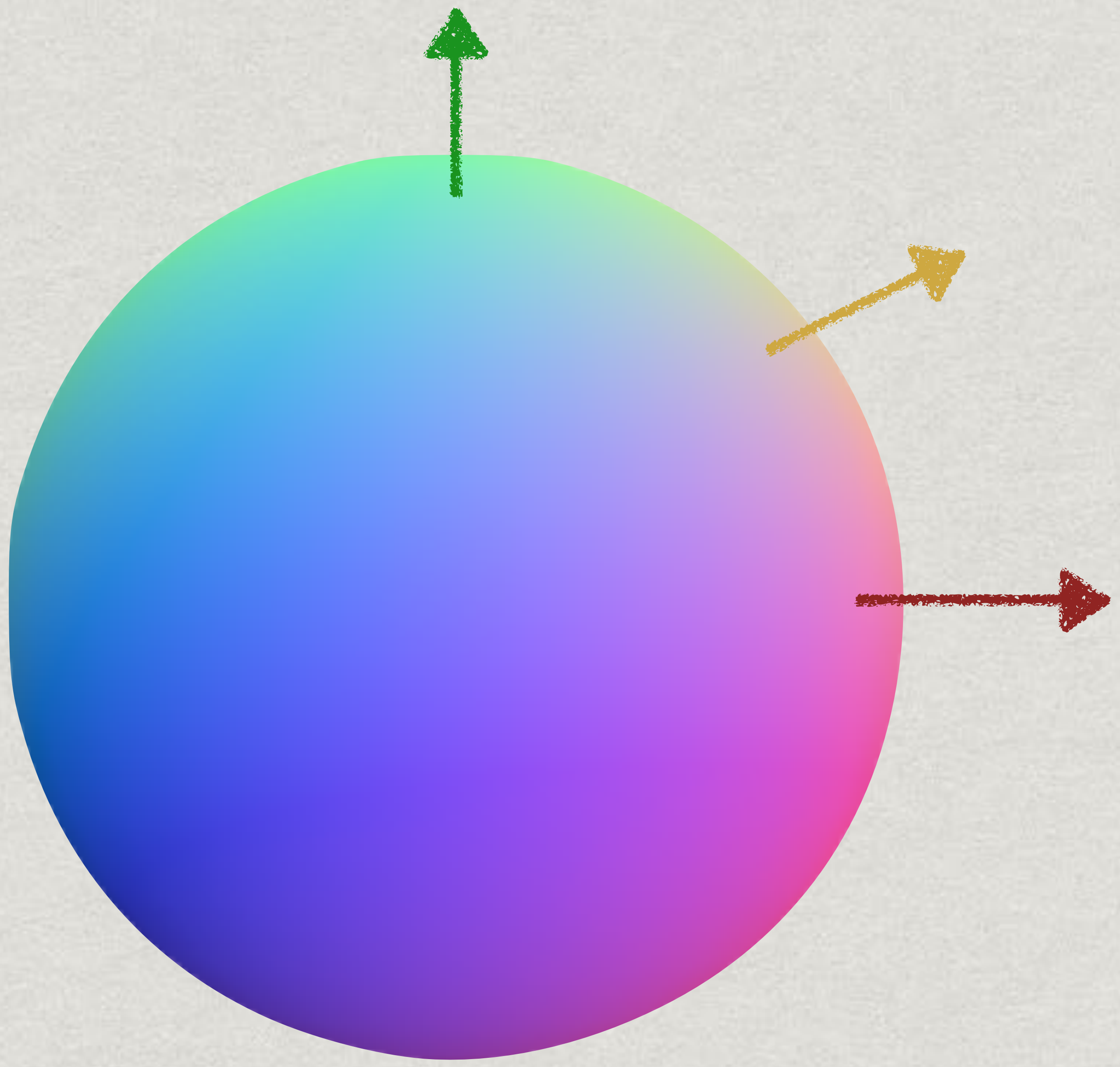




Normal Material

- At the pole, the **green vector** is pointing upward without any tilting in the **x nor z directions**. Therefore, this vector is **(0, 1, 0)**.
- Normal material simply uses this vector as the **color vector**, which defines the (**red, green, blue**) components.
- Thus, the pole spot is purely green.

Normal Material and Sphere



- On a sphere, **every normal vector is different**.
  They points to a different direction.
- Thus, this gives a colorful result.
- Vector is more often written “vertically”.

$$\begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$$