# Computer Graphics 1
*LMU Munich SS20*

## Rendering

- Texturing
  - Texture map
    - Braycentric interpolation
      - Texture coordinates
      - Texture color
      - Normal vectors
      - ...
    - Texture Sampling
      - Magnification
        - Nearest
        - Bilinear
        - Bicubic
      - Minification
        - Mipmap
          - Level
          - Trilinear Interpolation
        - Anisotropic Filtering
  - Environment map
    - Spherical environment map
  - Bump map
- Shadowing
  - Shadow map
- Shading
  - Lights
    - Point Light
    - Area Light
    - Directional Light
    - ...
  - The Blinn-Phong Reflection Model
    - Ambient
      - Ambient Shading Hypothesis
    - Diffuse
      - Lambertian Diffuse Term
    - Specular
      - Blinn-Phong Specular Term
  - Shading Frequency
    - Flat Shading
      - Per Face
    - Gouraud Shading
      - Per Vertex
    - Phong Shading
      - Per Pixel
- Global Illumination
  - Ray Casting
    - Ray equation
    - Ray intersection with triangles
  - Light transportation
    - Radiocity
      - Radiant energy
      - Flux
      - Radiant intensity
      - Irradiance
      - Radiance
    - The reflectance equation
      - BRDF
        - Lambertian
        - Glossy
        - Reflective / Refractive
        - Microfacet
    - The rendering equation
      - Direct Illumination
      - Indirect Iluumination
      - Bounce Exploding
  - Whitted-style ray tracing
  - Path tracing
    - Monte-carlo Integration
    - Russian Roulette
    - Light Sampling
    - Noise Reduction

## Rasterization

- Transformation
  - Affine Map
    - Identity
    - Translation
    - Scaling
    - Rotation
      - Euler Angles
        - Issue: Gimbal Lock
      - Quaternions
  - Camera Map
    - Camera Translation
    - Camera Rotation
    - Orthographic
    - Perspective
      - Application: Dolly Zoom
- Geometry
  - CSG
    - Boolean operation
  - Mesh
    - Curves
      - Bézier Curves
        - Algebraic formula
        - de-Casteljau algorithm
    - Surface
      - Bézier Patches
    - Tri v.s. Quads
    - Manifold v.s. Non-manifold
    - Normals
      - Face normal
      - Vertex normal
    - Mesh Sampling (LOD)
      - Upsampling
        - Loop Subdivision
      - Downsampling
        - Vertex Clustering
        - Edge Collapse
        - Progressive Polygon Reduction
  - Point Cloud
  - Voxel
- Culling
  - View frustum culling
    - Octrees
    - Bounding Volume Hierarchy
    - Axis-aligned Bounding Box
  - Back face culling
  - Occlusion culling
- Clipping
  - Cohen & Sutherland algorithm
  - Liang-Barsky Algorithm
- Occlusion
  - Depth buffer
    - Z-buffering
    - Z-fighting
  - Frame buffer
- Drawing
  - Lines
    - Bresenham algorithm
  - Polygons
    - Scan line algorithm
  - Pixel Sampling
    - Aliasing
    - Antialiasing
      - Wu's Algorithm
      - Super sampling
        - MSAA
        - FXAA
        - TAA
        - DLSS
- Graphics API: three.js
  - Renderer
  - Scene
  - Camera
    - OrbitControl
    - OrthographicCamera
    - PerspectiveCamera
  - Mesh
  - Geometry
    - PlaneGeometry
    - SphereGeometry
    - CylinderGeometry
    - ...
  - Material
    - MeshPhongMaterial
    - ShaderMaterial
    - ...
- Graphics API: OpenGL 4.5
  - Drawing Mode
  - Programmable Shaders
    - Vertex Shader
    - Fragment Shader
    - Geometry Shader
    - Compute Shader
  - GLSL 3.0
    - in
    - out
    - attribute
    - uniform
    - discard
    - gl_Position
    - ...
  - GPU

## Animation

- 12 Principles
  - Squash and stretch
  - Anticipation
  - Staging
  - Straight ahead and pose-to-pose
  - Follow through
  - Ease-in and ease-out
  - Arcs
  - Secondary action
  - Timing
  - Exaggeration
  - Solid drawings
  - Appeal
- Techniques
  - Key framing
    - Linear Interpolation
    - Spline Interpolation
  - Motion Capturing
  - Simulation
    - Inverse Kinematics
    - Particle systems

## Interaction

- Input Devices
- World Navigation
  - Moving Modes
- Objects Interaction