Computer Graphics 1

Tutorial

Assignment 5

Summer Semester 2024

Ludwig-Maximilians-Universität München

Contact

If you have any questions:

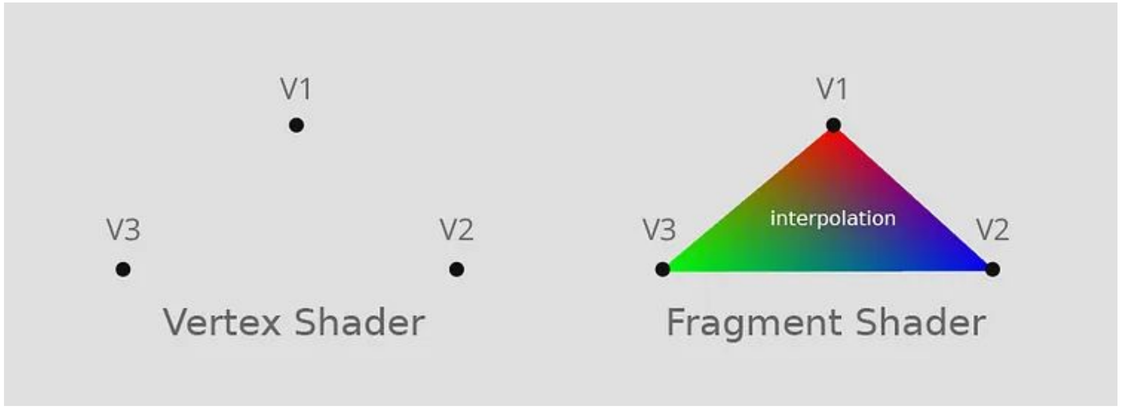
cg1ss24@medien.ifi.lmu.de

Organization

- **Theoretical part:**
  - Prepares you for the exam
  - Solve the tasks at home
  - We present the solutions during the tutorial sessions
- **Practical part:**
  - We will indicate which parts you need to do at home
  - Else this will be done & explained during the tutorial session
  - Ask questions!

Task 1 Recap: What is a Shader?

- Definition: A shader is a type of computer program used in 3D graphics to determine the final appearance of graphics on the screen. They run on the GPU and can handle tasks like calculating lighting, shadowing, and color effects during the rendering process.
- Types of Shaders:
  - Vertex Shaders: Transform vertex positions
  - Pixel (Fragment) Shaders: Calculate color and other attributes of each pixel



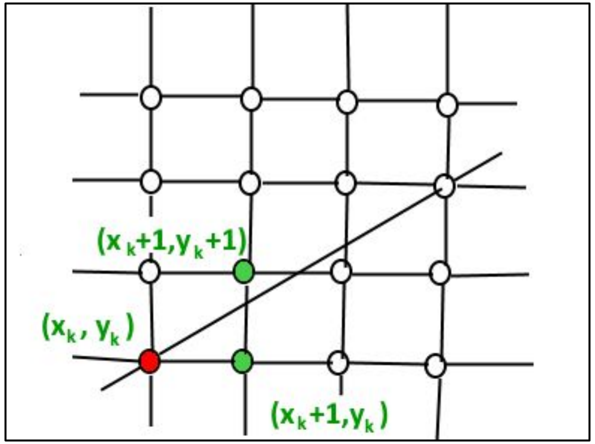
Task 1 Recap: Raytracing

- Definition: Raytracing is a rendering technique that simulates the way light interacts with objects to produce realistic images. It traces the path of light as pixels in an image plane and simulates effects like reflections, refractions, and shadows.
- Benefits: Produces highly realistic images
- Challenges: Computationally intensive, often requiring powerful hardware or optimizations

Raytracing
RTX on
RTX off

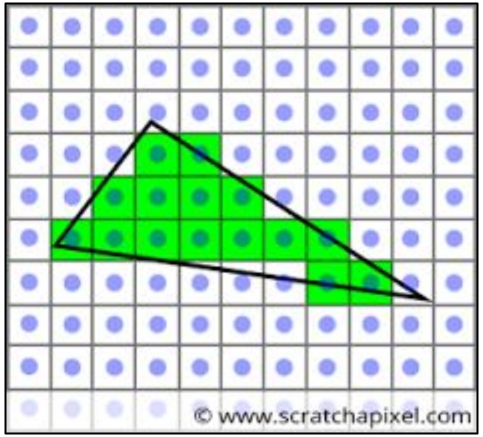
Task 1 Recap: Bresenham’s Algorithm

- Definition: Bresenham's algorithm is an efficient way to draw lines or circles with a clear distinction and minimal calculation, which is ideal for raster devices.
- Working Principle: Uses integer arithmetic to decide the next pixel location, minimizing floating-point calculations
- Application: Commonly used in graphics libraries to draw lines and shapes



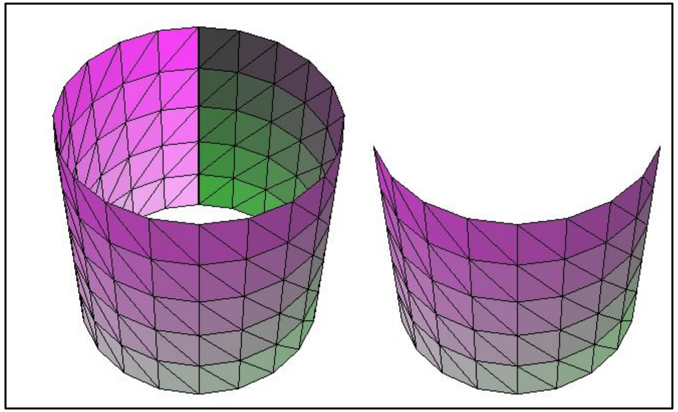
Task 1 Recap: Rasterization

- Definition: Rasterization is the process of converting vector graphics (like a line, triangle, or shape) into a raster image (pixels or dots) for output on a video display or printer.
- Steps: Involves filling in the pixels to represent the shapes based on line and edge equations
- Importance: Fundamental technique in real-time graphics rendering, especially in video games and user interfaces



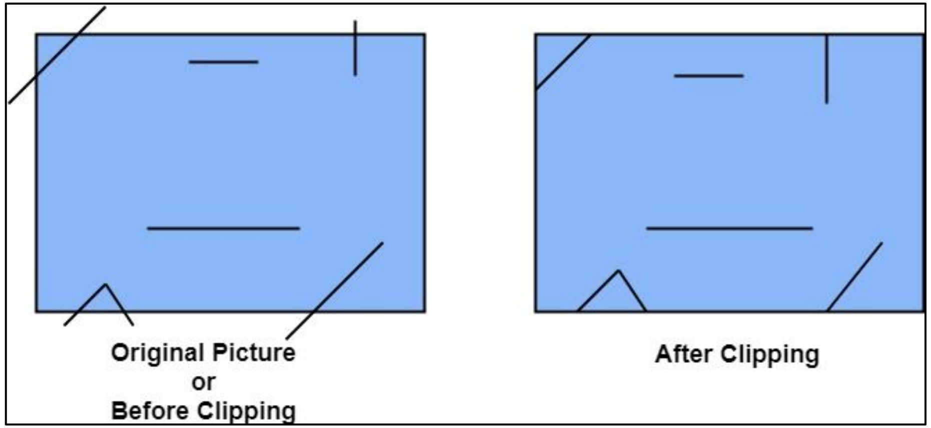
Task 1 Rasterization

- **View frustum culling** is the process of removing objects that are outside the viewer's visible area (frustum) to improve rendering efficiency.
- **Back face culling** involves discarding polygons that face away from the viewer, reducing the number of polygons that need to be rendered.
- **Occlusion culling** removes objects from the rendering process that are completely blocked by other objects, saving computational resources.



Task 1 Rasterization: What is the purpose of clipping?

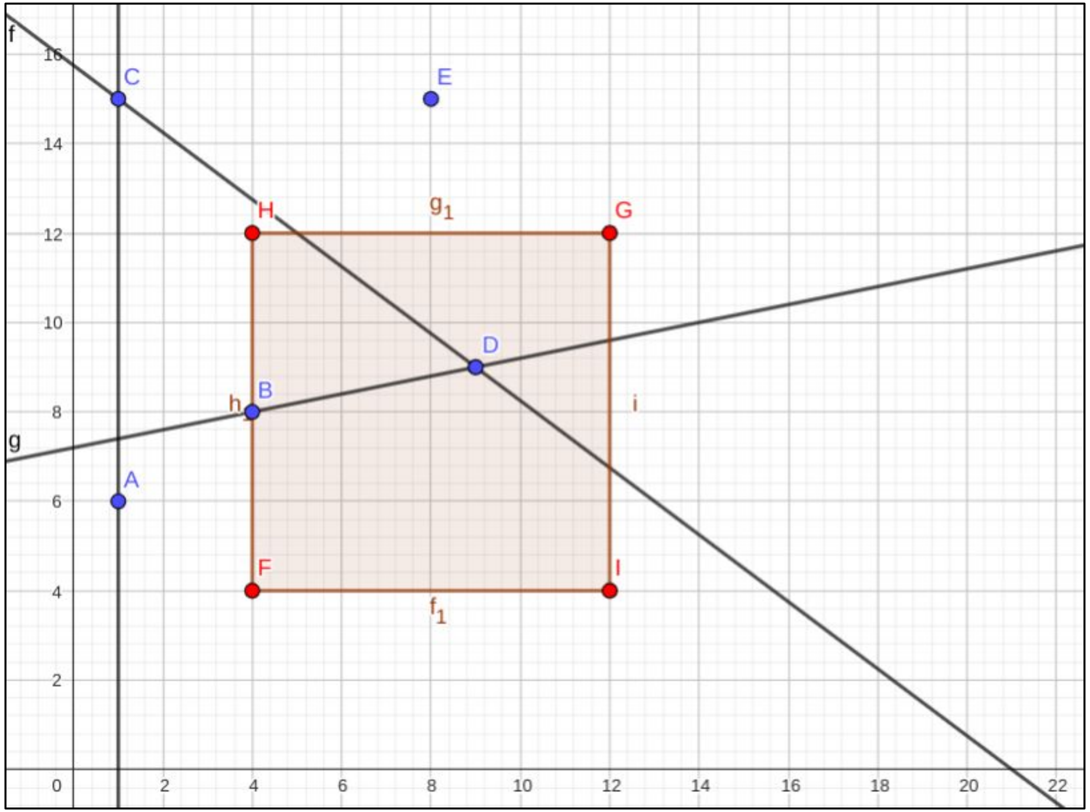
- Purpose of Clipping: Clipping is used to restrict the rendering to only objects or parts of objects within a predefined region, such as the view frustum, improving performance and resource management.
- Common Issue with Clipping: One issue that can arise is the "clipping artifact," where parts of the object that should be visible are improperly clipped, leading to visual errors



Task 1 Rasterization: Clipping Algorithm - Cohen-Sutherland

- Definition and Function: The Cohen-Sutherland algorithm is used for line clipping in computer graphics. It categorizes points (ends of a line) based on their location relative to the clipping window using a region code.
- Working Principle: Each point of the line segment is assigned a code that identifies its position relative to the bounding box. The algorithm repeatedly checks whether the endpoints of the line segment are inside or outside the clipping window and computes intersections with the clip boundary until the segment is either accepted as being within the window or rejected if it lies outside.

Task 2: 1



Task 2 a)

- Point a [1,6]
  - Left of 4 (Left bit = 1)
  - Not above 12, not below 4 (Top and Bottom bits = 0)
  - Outcode = 0001 (left)
- Point b [4,8]:
  - On left edge 4 (considered inside, Left bit = 0)
  - Not above 12, not below 4 (Top and Bottom bits = 0)
  - Outcode = 0000

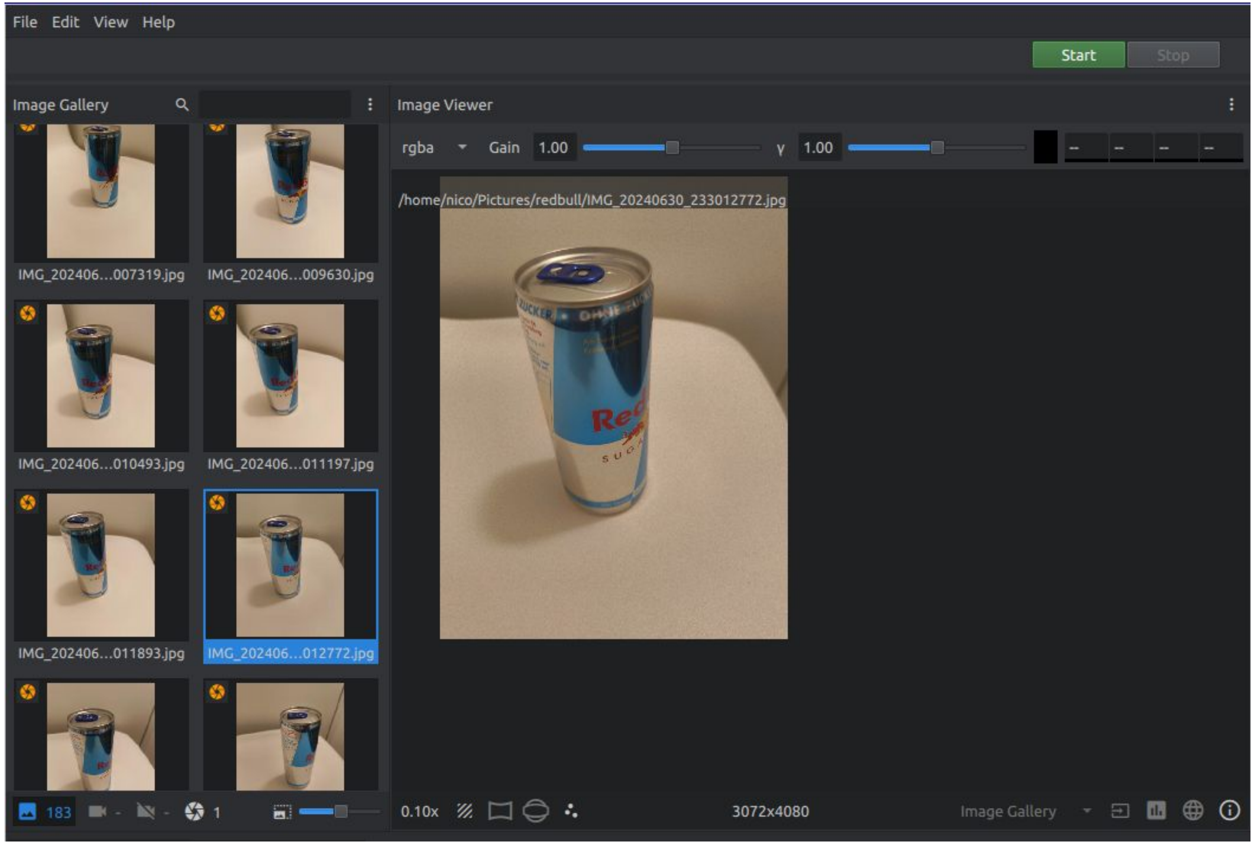
Task 2 a)

- Point c [1,15]:
  - Left of 4 (Left bit = 1)
  - Above 12 (Top bit = 1)
  - Outcode = 1001
- Point d [9,9]:
  - Inside the window (All bits = 0)
  - Outcode = 0000
- Point e [8,15]:
  - Inside the boundaries of left-right (All bits = 0 except Top)
  - Above 12 (Top bit = 1)
  - Outcode = 1000

Task 2 b) c) d)

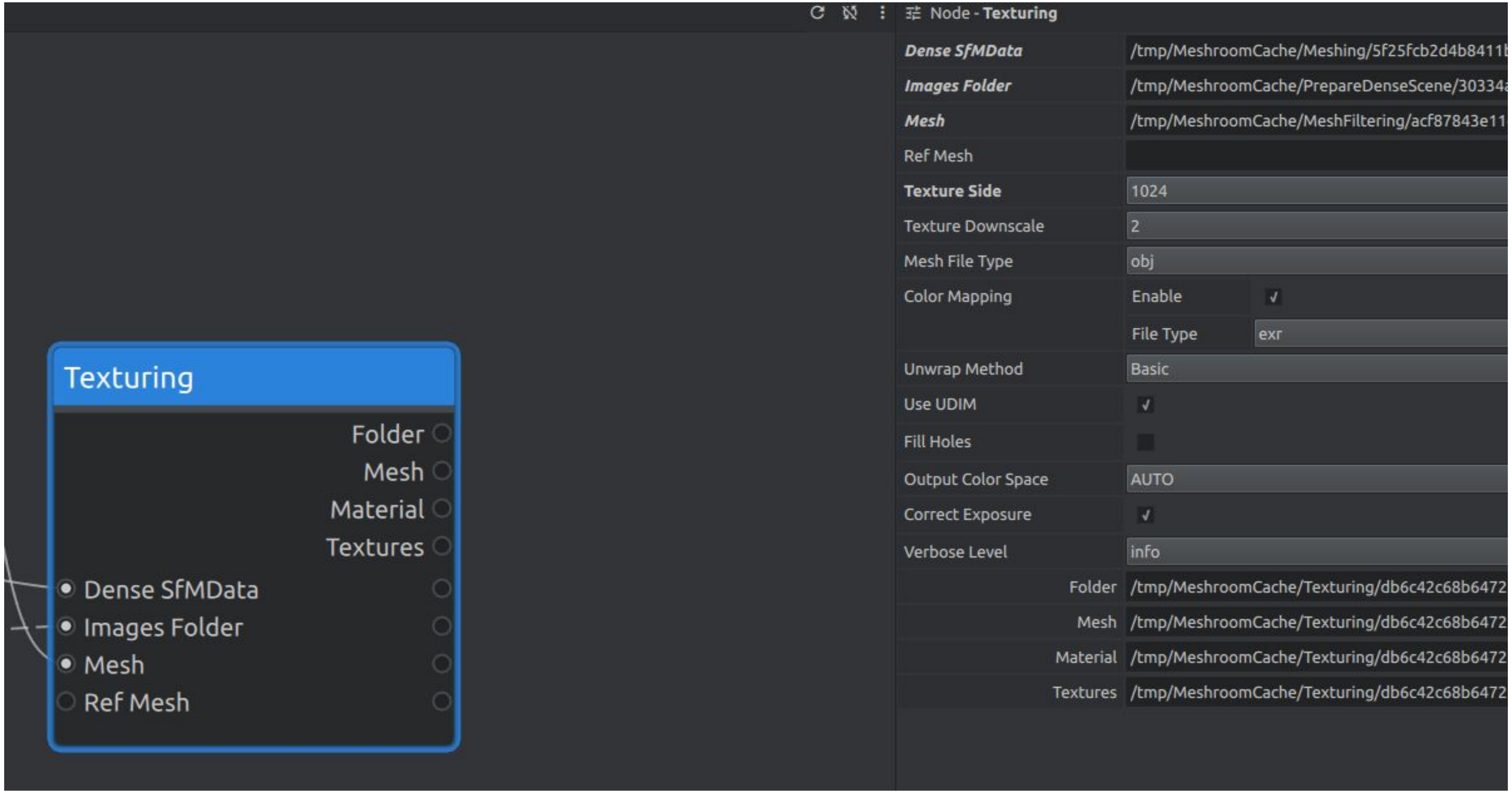
- Line cd [c–>d]:
  - **OR(c, d)**: 1001 OR 0000 = 1001
  - **AND(c, d)**: 1001 AND 0000 = 0000
  - **Decision:** Clip (OR is not 0000 but AND is 0000; indicates partial visibility outside window)
- Line db [d–>b]:
  - **OR(d, b):** 0000 OR 0000 = 0000
  - **AND(d, b)**: 0000 AND 0000 = 0000
  - **Decision**: Draw (both OR and AND are 0000; fully within the window)
- Line ac [a–>c]:
  - **OR(a, c)** = 0001 OR 1001 = 1001
  - **AND(a, c)** = 0001 AND 1001 = 0001
  - **Decision:** Skip (AND is not 0000; both share common region outside the window, skipped entirely)

Practical Task: Photogrammetry



/home/nico/Pictures/redbull/IMG_20240630_233012772.jpg

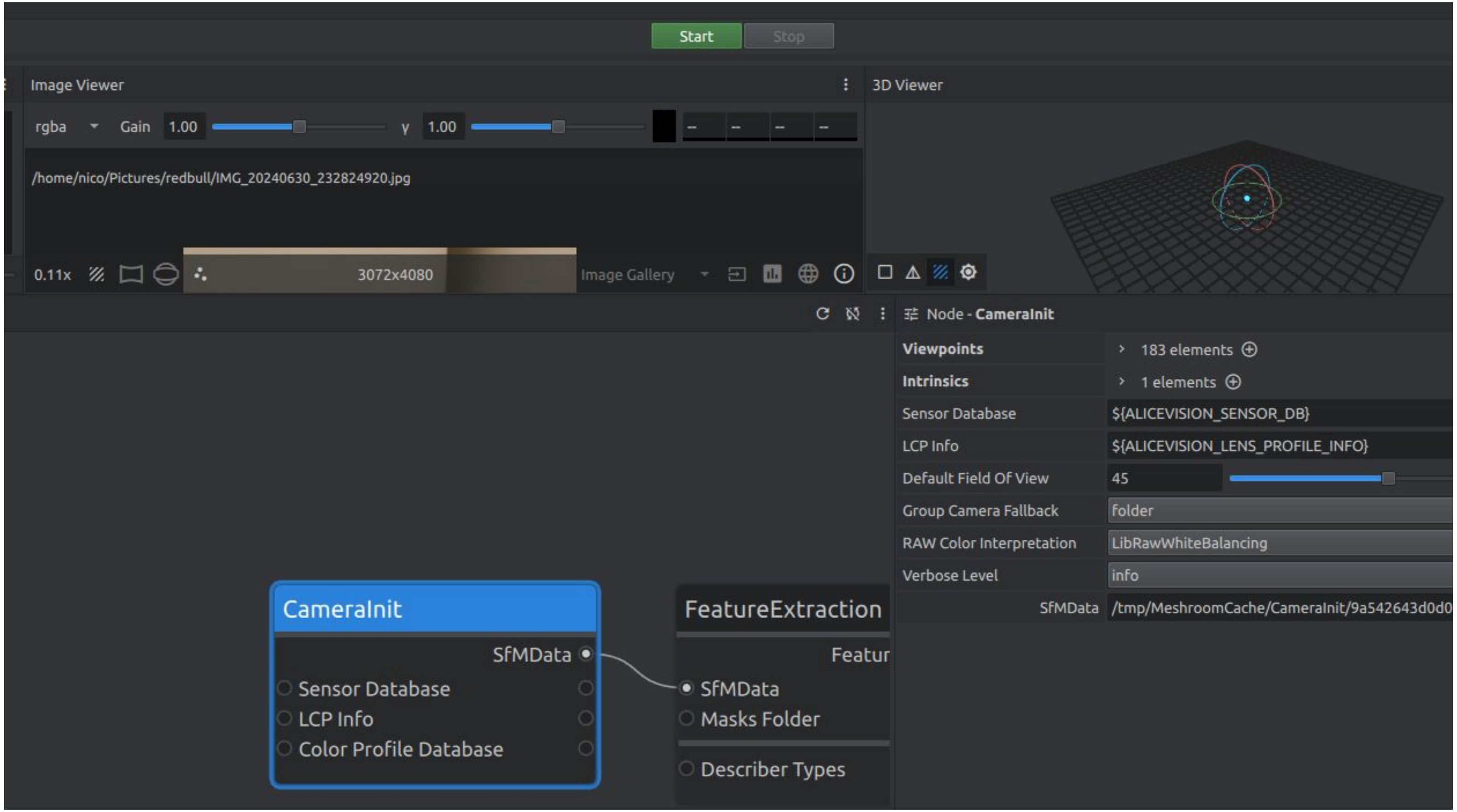
Practical Task: Photogrammetry



Node - **Texturing**

Dense SfMData	/tmp/MeshroomCache/Meshing/5f25fcb2d4b8411	
Images Folder	/tmp/MeshroomCache/PrepareDenseScene/30334	
Mesh	/tmp/MeshroomCache/MeshFiltering/acf87843e11	
Ref Mesh		
Texture Side	1024	
Texture Downscale	2	
Mesh File Type	obj	
Color Mapping	Enable	✓
	File Type	exr
Unwrap Method	Basic	
Use UDIM	✓	
Fill Holes		
Output Color Space	AUTO	
Correct Exposure	✓	
Verbose Level	info	
Folder	/tmp/MeshroomCache/Texturing/db6c42c68b6472	
Mesh	/tmp/MeshroomCache/Texturing/db6c42c68b6472	
Material	/tmp/MeshroomCache/Texturing/db6c42c68b6472	
Textures	/tmp/MeshroomCache/Texturing/db6c42c68b6472	

Practical Task: Photogrammetry



/home/nico/Pictures/redbull/IMG_20240630_232824920.jpg

Node - **CameraInit**

Viewpoints	183 elements
Intrinsics	1 elements
Sensor Database	${ALICEVISION_SENSOR_DB}
LCP Info	${ALICEVISION_LENS_PROFILE_INFO}
Default Field Of View	45
Group Camera Fallback	folder
RAW Color Interpretation	LibRawWhiteBalancing
Verbose Level	info
SfMData	/tmp/MeshroomCache/CameraInit/9a542643d0d0