

# CuRLI\_v1

CS6610 Interactive Computer Graphics HW repository. Stands for **CompUter Renders Lot of Images**. It is intended as a toy renderer/course-project.

**Note to TAs:** If you are viewing this as a PDF it is the same document as the [ReadMe.md](#) so you may use that if it is more convenient.

## Building CuRLI for Windows

Building CuRLI for windows requires Cmake 3.0

### Dependencies

Most of these dependencies are included as submodules and compile with CMake. Only dependency that does not exist as submodule is glad which can be downloaded from generated link obtained [glad web page](#).

- MSVCv143 - VS2022 C++ or above
- [Cmake 3.0](#)
- [GLM](#)
- [ImGui](#)
- [GLFW](#) ~~FreeGlut~~
- [Glad](#)
- [cyCodeBase](#)(only for .obj importer ATM)
- [EnTT](#)

### Building with Cmake

1. Clone or download the files(unzip the downloaded files).
2. Create a folder to *build* binaries.
3. Run CmakeGui or Cmake select source as the project root directory and where to build binaries as *build* folder.
4. Select Visual Studio 17 2022 as the generator.
5. Configure and Generate
6. Navigate to *build* folder and open curli.sln file with Visual Studio

7. Select Under Build>Build solution(F7)

8. Run the executable i.e. **./curli.exe [params]** from console

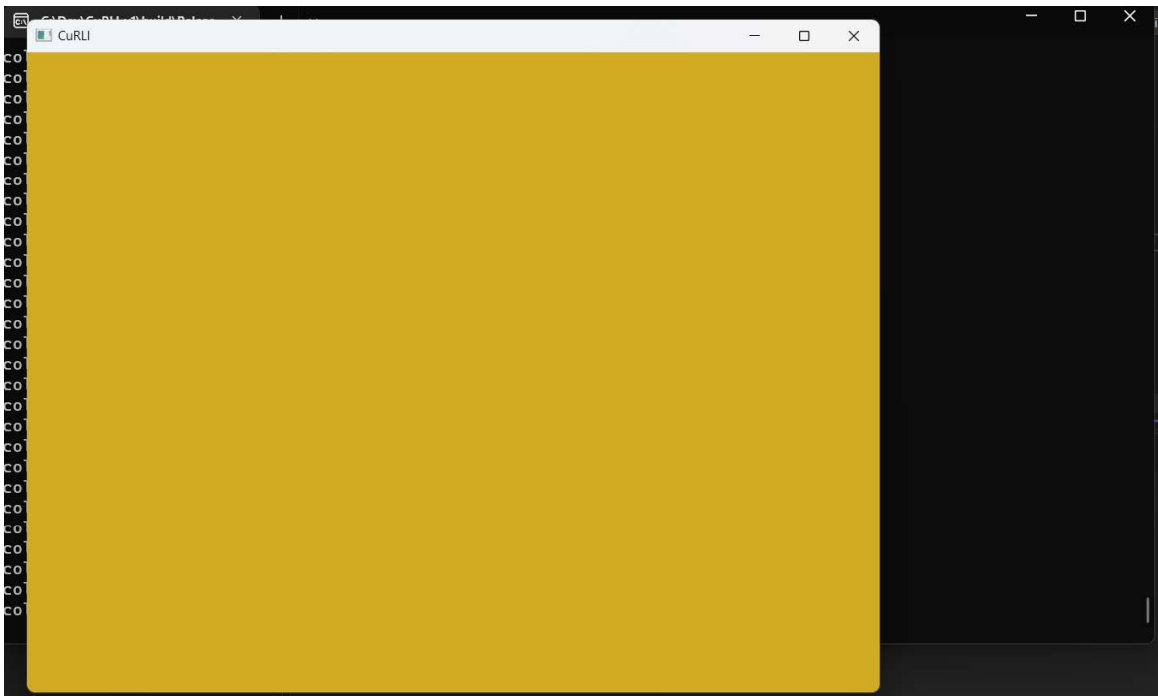
## Milestones

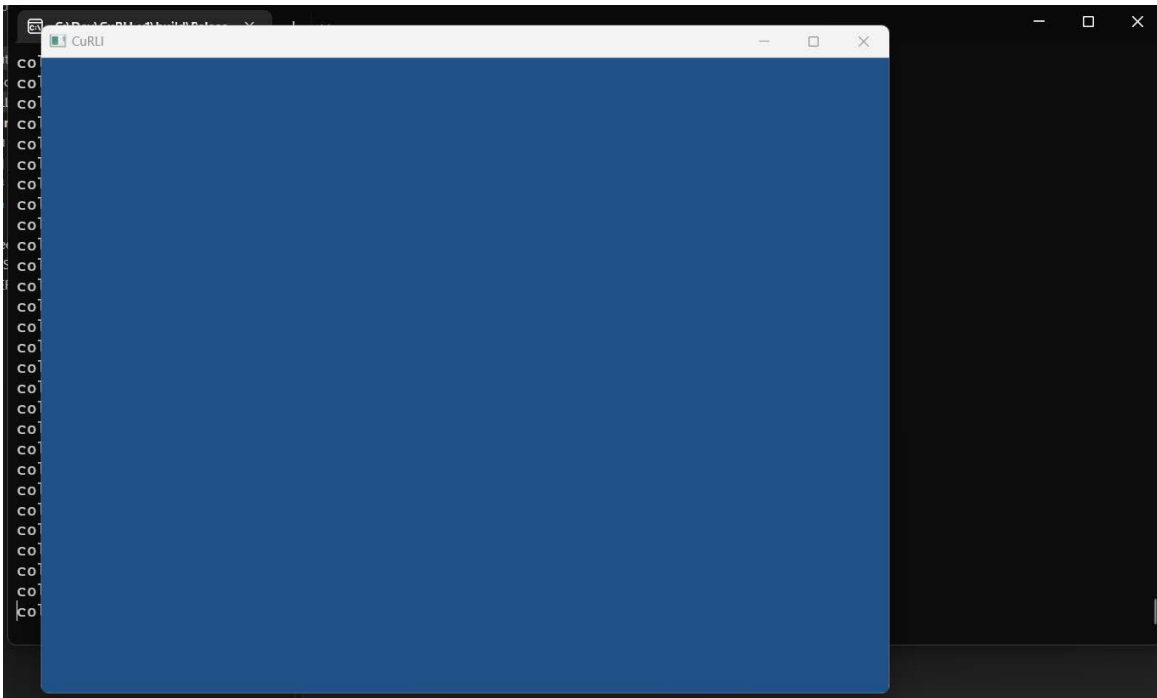
### Project 1 - H\*llo World

#### Project 1 requirements:

- ✓ Creating Window context
- ✓ Keyboard listeners where 'esc' is used to call `glutLeaveMainLoop()`;
- ✓ Setting window size, position, name and clear color during initialization.
- ✓ Idle function where animation between two colors are generated using linear interpolation of sine value of time(ms).

Some Screenshots:





## Project 2 - Transformations

### Project 2 requirements:

- ✓ Integrated `cyTriMesh` class to load `.obj` files from console arguments. Now path to a `.obj` mesh needs to be given to executable as the first argument as follows: `./curl.exe path/to/mesh`
- ✓ Implemented very simple shaders (`/assets/shaders/simple/...`) to transform and render vertex points in a constant single color as `GL_POINTS`.
- ✓ Implemented tarball controlled `lookAt` camera where `left mouse button + drag` adjusts two angles of the camera and `right mouse button + drag` adjusts the distance of the camera to *center*.
- ✓ Programmed a `ImGui` window and keyboard shortcuts that allows reloading( `F5` ) and recompiling( `F6` ) of the shader files. This means that one can edit shader files after `curl` launches, pressing `F5` and `F6` will use the edited shaders if compilation is successful.
- ✓ `ImGui` window also includes a button that recenters camera( `F1` ) to the mesh center point.
- ✓ Pressing `P` also lets user switch between orthographic and perspective projection types.

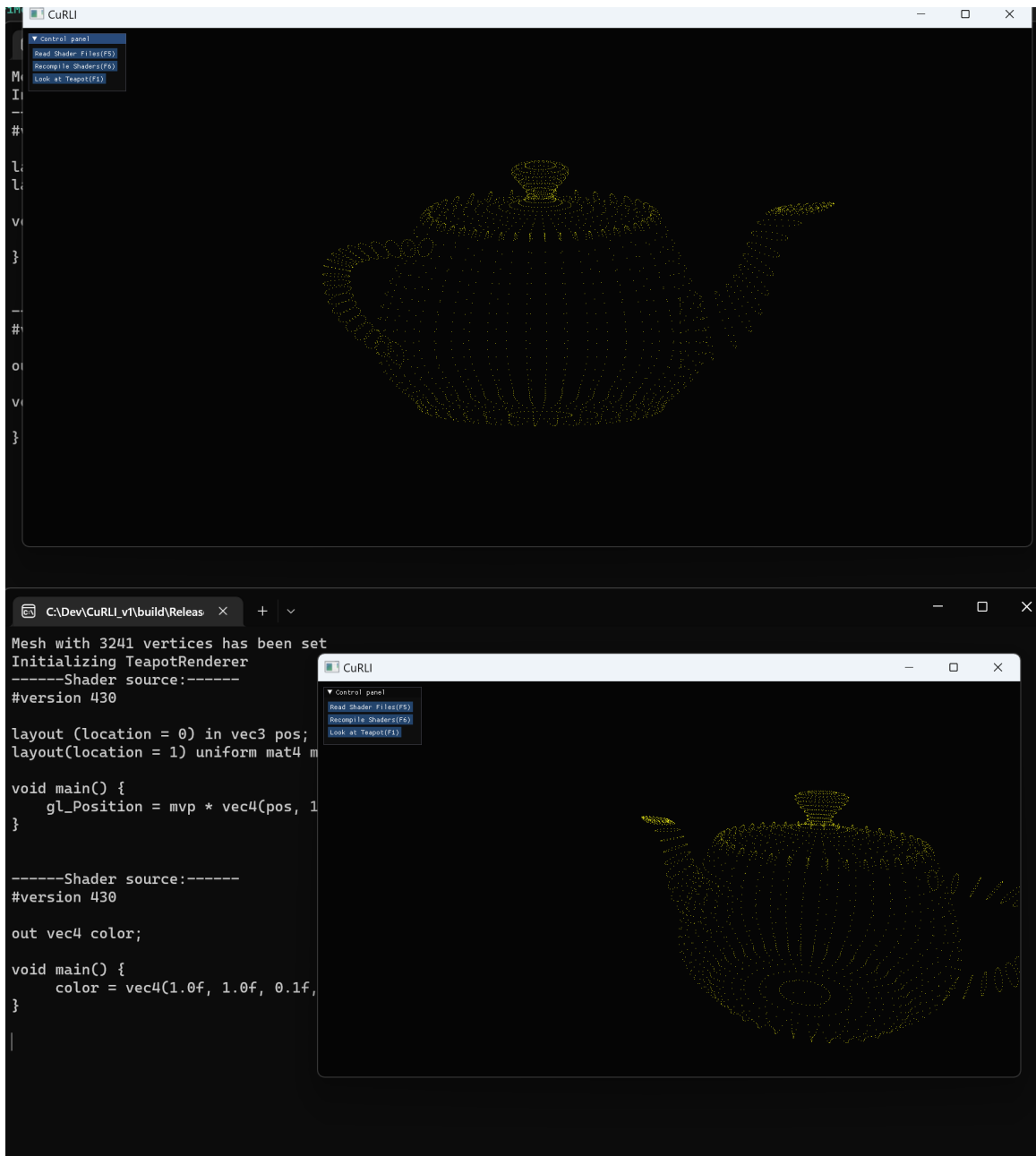
### Additional Features:

- [Curiously recurring template pattern](#) has been utilized to have staged renderers and application.
  - Application stages are: `Initialize()`, `Render()`, `DrawGui()`, `Terminate()`. `Render` and `DrawGui` are called in a render loop.
  - Each renderer `A` that implements base class `Renderer<A>` will need to override `Start()`, `PreUpdate()`, `Update()` and `End()`. These functions are called on various stages of the

application allowing customizable renderers to be written.

- Also programmed a simple event dispatcher system which gets the input&windowing events by `glfw` to be queued. The queued event is resolved in render loop.
  - Each renderer has the option to override certain event calls dispatched by the system if the functions are overridden they are called by the `dispatchEvent()`
- Inside `PreUpdate()` function of this projects renderer ( `TeapotRenderer` ) I set the model matrix of the teapot to a rotation matrix that updates the angle over time. This causes teapot to revolve around itself.

Some Screenshots:



# Project 3 - Shading

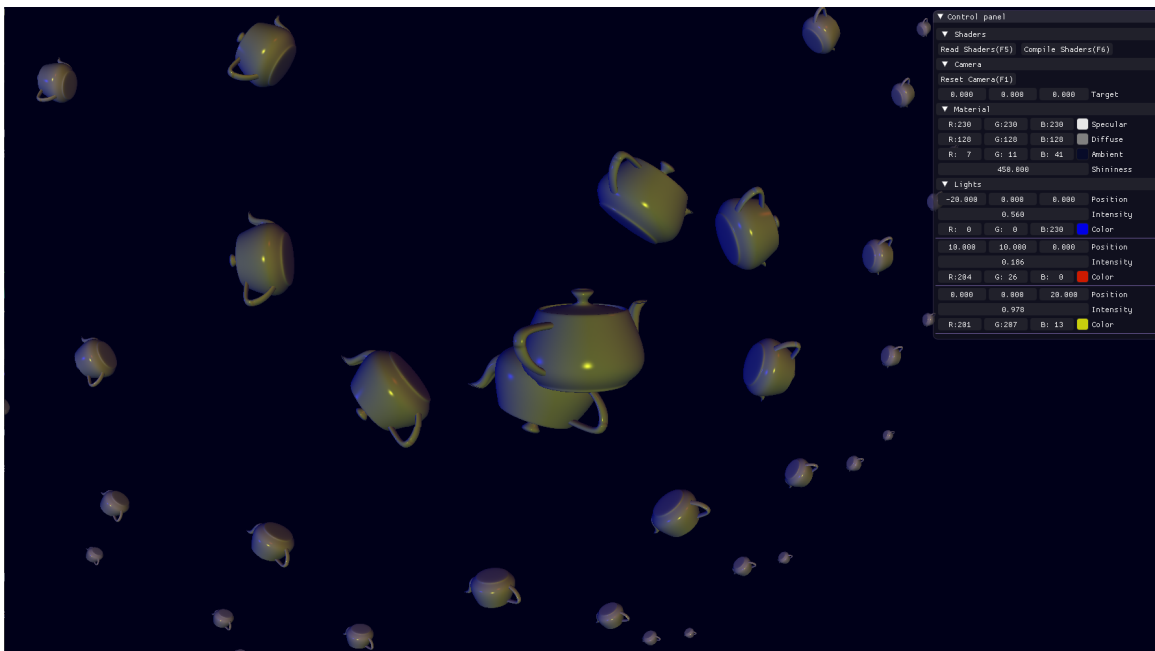
## Project 3 requirements:

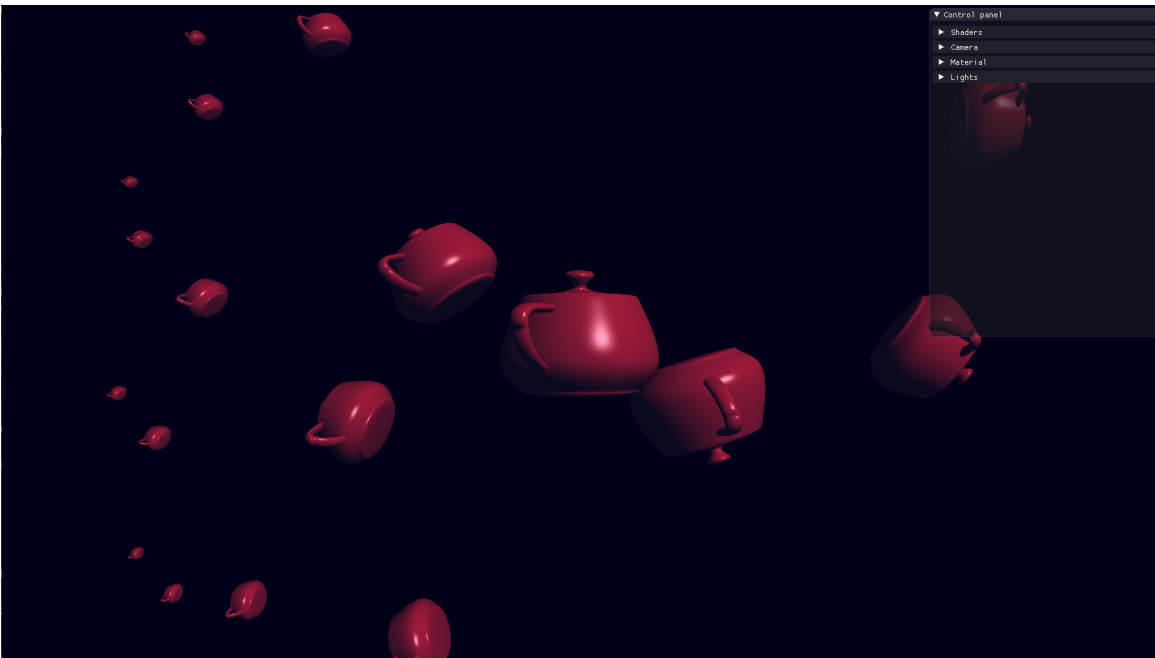
- ✓ Displayed triangles instead of points
- ✓ Uploaded and transforming vertex normals using inverse transpose of model view matrix
- ✓ Implemented Blinn-Phong shading in view space using half angles.
- ✓ Added orbital controls to the first point light source inserted into the scene.

## Additional Features:

- Integrated EnTT --- an entity-component system.
  - Using EnTT several components have been developed:
    - `CLight` : Illuminates the scene currently only as point light but soon other types will be implemented.
    - `CTransform` : A transform component that is traditionally used to generate model matrices for shaders
    - `CTriMesh` : Wrapper for `cyTriMesh` allows entities to have geometry
    - `CVertexArrayObject` : Allows geometry to be drawn using bound VBOs and EBO(optional). Automaticly handles and selects which draw calls to make.
- Implemented `OpenGLProgram` abstraction which allows convenience binding shaders and uploading uniforms.
- Using the ECS I let shaders render multiple light sources over multiple objects.

## Some Screenshots:



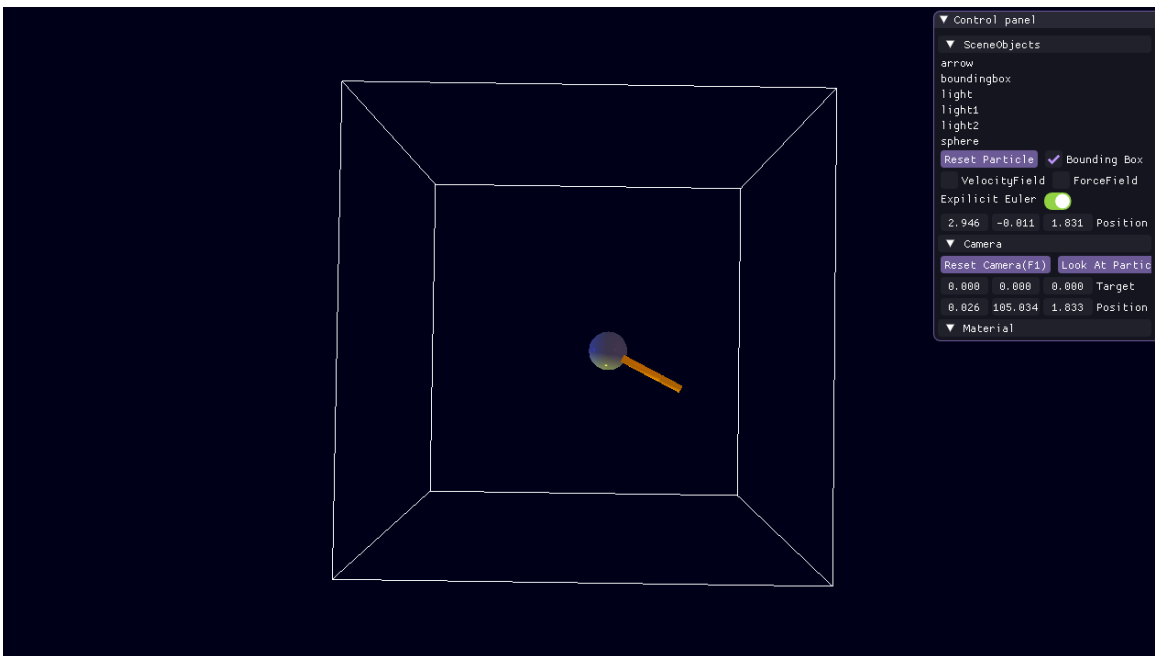


## Physically Based Animation - Assignment 1

### A simple one-particle system:

- ✓ Rendering and shading 3D sphere as a particle.
- ✓ LShift + Mouse drag can interactively apply force.
- ✓ 3D arrow as force vector indicator.
- ✓ Programmable VelocityField2D component with respective UI to add/remove from the scene.
- ✓ Programmable ForceField2D component with respective UI to add/remove from the scene.
- ✓ Euler integrator (explicit or implicit) and its selection UI.
- ✓ BoundingBox class with VertexArrayObject component so it can be drawn as GL\_LINES.

Some Screenshots:



## Project 4 - Textures

### Project 4 requirements:

- ☐ Load and parse .mtl files associated with .obj files.
- ☐ Load and decode .png files as textures.
- ☒ Use cmdline to read .obj files
  - Usage `-model --path ../path/to/your.obj`
  - Appending `--rb` after `-model` tag attaches `CRigidBody` component to the model which includes this object in WIP physics events.
- ☐ Display textures properly on the object.
- ☐ Include the specular texture, specified in the mtl file, for adjusting the specular color of the object.

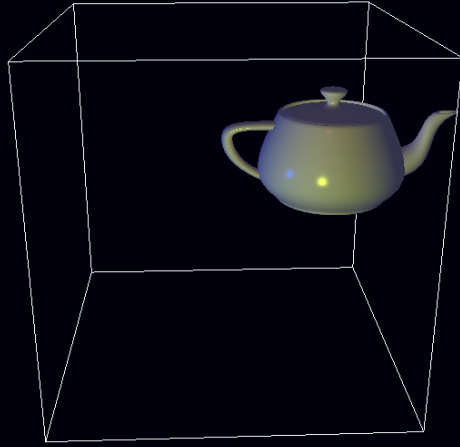
### Additional Features:

- Improved UI using ImGui and EnTT.
  - Now scene objects are displayed in a list.
  - Selecting an object from a list allows user to see different components attached to the object.
- Using the Top menu bar user can load .obj files.
  - `File>import .obj file`
- Again using the top menu bar user can add components to the selected scene object.
  - Under `Edit > Attach component`
- User can also create empty entities to attach objects to it using `Edit>Create Entity`

Some Screenshots:

File Edit

Create Entity CTRL+E  
Attach Component CTRL+Space



Control Panel

Scene Objects

bb  
light  
light1  
light2  
teapot

VAO Boundingbox

Vertex Array object info

Visible

GL\_LINES

Attribute: pos (layout = 9)

Count: 24

Attrib Size: 3

Stride: 0

Offset: 0

Camera

Look at: Default Camera