

# Final Project, Part II

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**Due** Mar 1 by 11:59pm    **Points** 100    **Submitting** a file upload    **File Types** zip and rar  
**Available** Feb 6 at 10am - Mar 2 at 6am 24 days

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This assignment was locked Mar 2 at 6am.

**Demo Video** (<https://video.wpi.edu/Watch/Nc24LoKa>) (no audio)

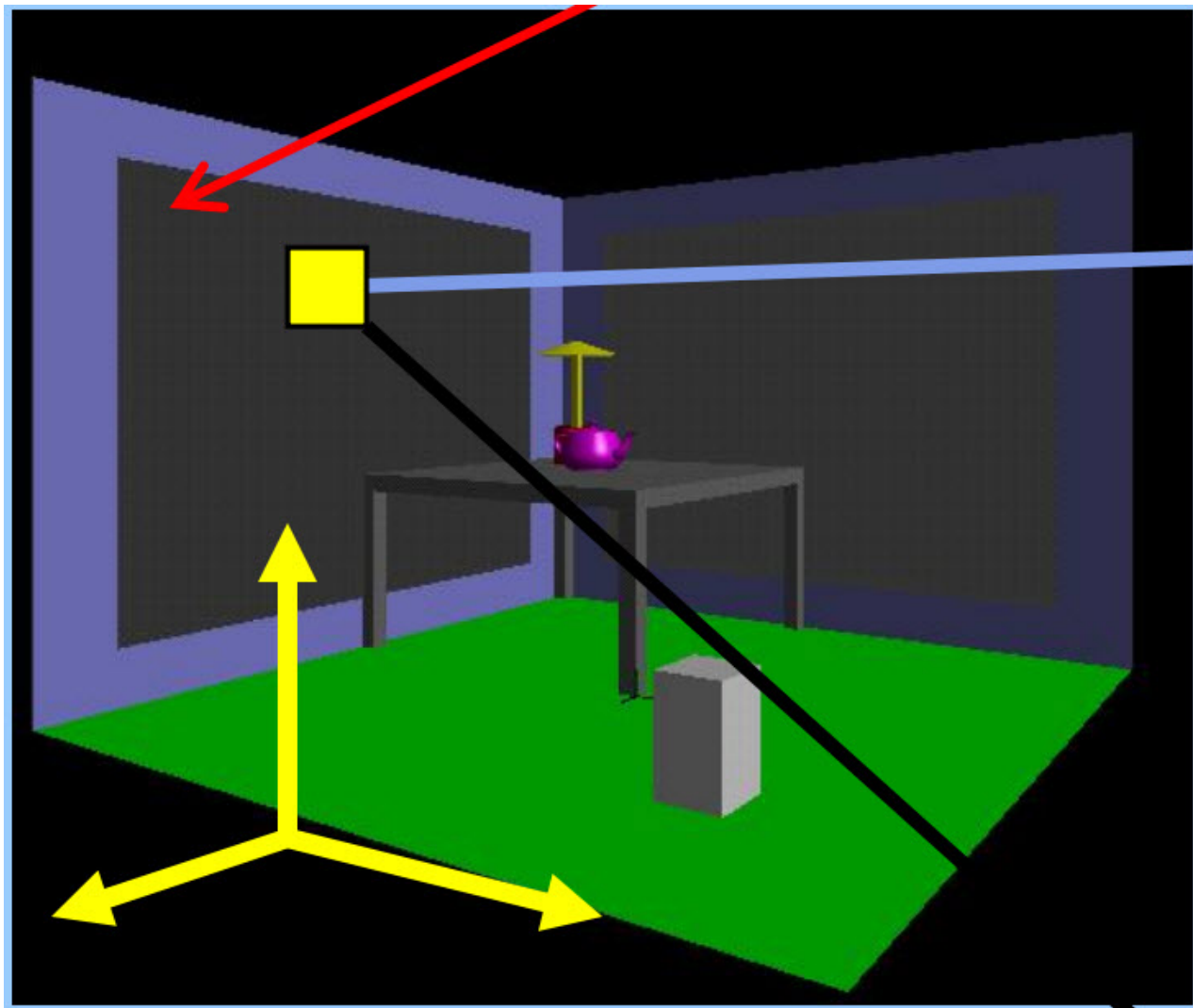
## Overview:

In this project you will add more realism to your hierarchy from Part I by adding texturing and shadows.

## First Steps:

In this project you will load textures in the bmp file format and use them to texture parts of your scene.

Beginning with your Part I submission, add a floor plane below your hierarchy and two walls behind it. You will implement shadows. The floor and walls will be surfaces on which the shadows can be cast. Your floor plane and two walls should be similar to the one shown below. You do not have to render the scene objects (table, rectangular block, lamp shade and teapot).



## Texturing:

You can download the texture files here: [cs4731\\_pjt\\_textures.zip](#)

You can also reference the texture files at the following URLs:

Grass	<a href="http://web.cs.wpi.edu/~jmcuneo/grass.bmp">http://web.cs.wpi.edu/~jmcuneo/grass.bmp</a>
Stones	<a href="http://web.cs.wpi.edu/~jmcuneo/stones.bmp">http://web.cs.wpi.edu/~jmcuneo/stones.bmp</a>
Environment Map - Negative X	<a href="http://web.cs.wpi.edu/~jmcuneo/env_map_sides/nvnegx.bmp">http://web.cs.wpi.edu/~jmcuneo/env_map_sides/nvnegx.bmp</a>
Environment Map - Negative Y	<a href="http://web.cs.wpi.edu/~jmcuneo/env_map_sides/nvnegy.bmp">http://web.cs.wpi.edu/~jmcuneo/env_map_sides/nvnegy.bmp</a>
Environment Map - Negative Z	<a href="http://web.cs.wpi.edu/~jmcuneo/env_map_sides/nvnegz.bmp">http://web.cs.wpi.edu/~jmcuneo/env_map_sides/nvnegz.bmp</a>
Environment Map - Positive X	<a href="http://web.cs.wpi.edu/~jmcuneo/env_map_sides/nvposx.bmp">http://web.cs.wpi.edu/~jmcuneo/env_map_sides/nvposx.bmp</a>
Environment Map - Positive Y	<a href="http://web.cs.wpi.edu/~jmcuneo/env_map_sides/nvposy.bmp">http://web.cs.wpi.edu/~jmcuneo/env_map_sides/nvposy.bmp</a>
Environment Map - Positive Z	<a href="http://web.cs.wpi.edu/~jmcuneo/env_map_sides/nvposz.bmp">http://web.cs.wpi.edu/~jmcuneo/env_map_sides/nvposz.bmp</a>

**Texture the floor plane with grass and walls with stone:** Texture map some grass onto the floor of your scene to make it look like grass is growing. Use the grass texture file. Make it look like the walls were made of stone by texturing both walls using the stone texture. Do not try to stretch these small textures over a large floor (or walls). Instead, map each texture to the bottom left corner of the floor (or walls) undistorted and then repeat (i.e. tile) the texture to cover the entire floor.

**Shadows:** In class and in your readings, you learned about a simple technique to render shadows using projection. Implement this shadow algorithm such that the shadows of the hierarchy are projected in the direction opposite your light source and updated continuously as the hierarchy spins.

**Environment Mapping:** Add in reflective and refractive environment mapping using cubemaps to your scene. Use the cube map as your environment map. For reference purposes, the complete environment map looks like this:



Below is an image of a cow with reflection and refraction effects



**Reflection**



**Refraction**

#### Additional Keystrokes:

**Key A:** Toggle shadows ON/OFF. When ON, the shadows show up and when OFF the shadows do not show up.

**Key B:** Toggle ON/OFF between a scene with grass texture on floor and stone texture on the walls and a plain wall (no texturing). When ON, the floor is textured with grass and the walls are textured with stone. When OFF the floor and walls have no texturing, displaying a gray floor and blue walls.

**Key C:** Toggle reflection ON/OFF. When ON, the hierarchy is drawn with reflection. When OFF, the hierarchy objects are drawn with no reflection (rendered as a solid model(s) with Gouraud lighting). Select an appropriate shininess (reflectivity) for the models.

**Key D:** Toggle refraction ON/OFF. When ON, the hierarchy is drawn with refraction. When OFF, the hierarchy is drawn with no refraction ( rendered as a solid model(s) with Gouraud lighting). Select an appropriate refractive index for the hierarchy.

#### Extra Credit:

For this project, you are allowed to include additional features above and beyond the basic requirements. The instructor has sole discretion over the point value of each feature, and the student may earn up to 10 points total. To earn any credit, *you must list each feature in the comments at the top of your main \*.js file.*

To be eligible for extra credit, the additional features must be graphical in nature. This means that you show thought behind how something is presented to the user on screen or how the graphics are being processed behind the scenes.

#### Submitting Your Work:

Make sure to double-check that everything works before submitting. Put all of your files (JavaScript, HTML, etc.) into a folder and zip it. Please include your \*.ply files for ease of grading. Upload it to Canvas. Do not email me your program or submit it via a third-party cloud storage account.

Create documentation for your program and submit it along with the project inside the zip file. Your documentation can be either a pure ASCII text or a Microsoft Word file. The documentation does not have to be long. Briefly

describe the structure of your program and what each file turned in contains. Name your zip file according to the convention *LastnameFirstname\_Final2.zip*.

### Additional Notes:


- You are free to consult any resources you need to help you complete this assignment, including your classmates, the TA, the instructor, the class text, and any other books and websites. However, the code you turn in must be your own. **Any evidence of plagiarism will result in an automatic 0 for this assignment.**
- You are welcome to use any class coding examples (posted under "Modules") in your program. You are also welcome to use any code that the textbook authors (Angel and Shreiner) provide you.

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### FAQ:

#### Q: My shadows are weird flat planes that jut out into the scene.

Remember that the shadow transformation matrices simply project a flattened copy of your mesh onto one of the three primary planes ( $x = 0$ ,  $y = 0$ , or  $z = 0$ ). From there, you'll have to apply additional transformations to your shadow to position them in the correct place in your scene.

For a more detailed discussion of shadow implementation, please see the following page: [Implementing Shadows in the Final Project](#) (or download the PDF: [Implementing Shadows in the Final Project.pdf](#) .

#### Q: I keep getting the warning "WARNING: there is no texture bound to the unit 1".

In this project, you'll have to manage the fact that some objects in your scenes take textures and some don't (such as the lines of your mobile). Here's what I recommend: just pass a flag to your shaders to indicate whether or not the next set of vertices is something that takes a texture. Then you can use an if-statement in your fragment shader to set `gl_FragColor` accordingly.

This error can also occur if you are trying to access a texture image before the image is fully loaded. I recommend creating a default texture like we did in class and passing that to the same parameter in your fragment shader. Then, when your texture images are loaded and set, it will override the default.

#### Q: I've created a cube map with the appropriate textures, but the textures aren't showing up on my walls.

Cube maps don't work that way. They only exist in memory for purposes of reflection and refraction and otherwise are not rendered to the screen. If you wanted to make these images appear in your scene background as well, you'll have to texture your walls separately.

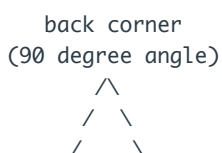
For this assignment, you should use the stone and grass textures on your walls and floor. It will look a little disjointed since the mobile won't be reflecting what you see on the walls, but it illustrates the difference between 2D mapping and cube mapping.

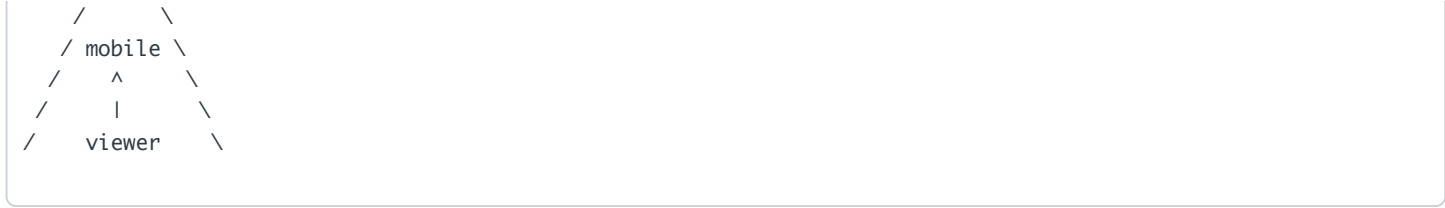
#### Q: I'm getting cross-origin error messages when I try to import the image files.

For security reasons, Chrome won't let you automatically import external files that are stored locally. This is why I set up the image URLs. Please make sure you are using those.

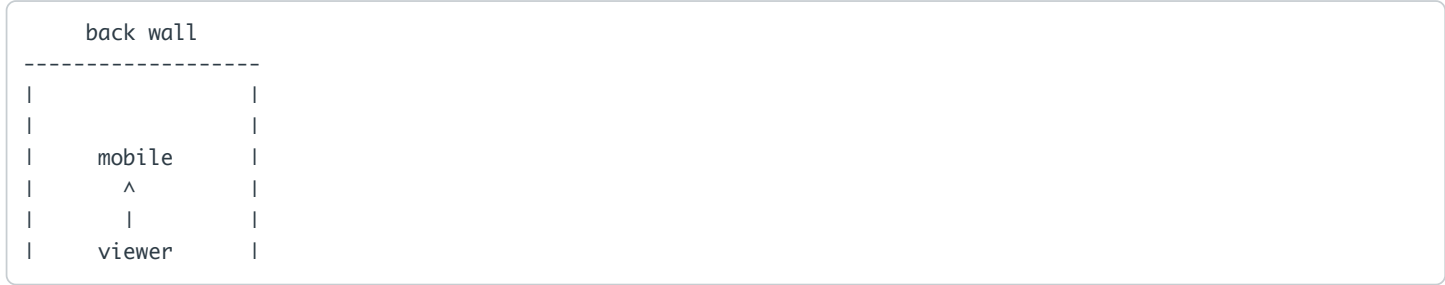
#### Q: Your demo video shows the viewer looking into a corner of the room. Do our walls and floor have to be oriented this way?

In the video, I have the scene oriented this way:





Some students find it easier to orient the scene such that the viewer is looking toward a back wall with the two side walls on the periphery, i.e.



Either orientation is fine, but in the latter case, please make sure both side walls are visible along with your back wall and floor.

**Final Project, Part II Rubric**

Criteria	Ratings		Pts
Part I Model Model preserves criteria for Object, Hierarchical Modeling, Animation, and Lighting from Part I.	15.0 pts Full Marks	0.0 pts No Marks	15.0 pts
Textures (2D) (10 pts each) - Walls and floor are present with stone and grass textures, respectively. - Textures are tiled instead of stretched.	20.0 pts Full Marks	0.0 pts No Marks	20.0 pts
Shadows (10 pts each) - Shadows are present and are opposite the light source direction. - Shadows are updated continuously as the hierarchy spins.	20.0 pts Full Marks	0.0 pts No Marks	20.0 pts
Environment Mapping (10 pts each) - Reflective and refractive environment mapping on the model are both present. - Cubemaps used.	20.0 pts Full Marks	0.0 pts No Marks	20.0 pts
Keyboard All keyboard commands implemented correctly.	15.0 pts Full Marks	0.0 pts No Marks	15.0 pts
Documentation and Organization (5 pts each) - Code is clean, well-commented, and easy to read - Documentation file describing structure of program and what it contains. File also indicates whether the program uses .ply files, and it describe the rough location and direction of the spotlight in the scene.	10.0 pts Full Marks	0.0 pts At least one of documentation file and code comments is missing	10.0 pts
Extra Credit	0.0 pts Full Marks	0.0 pts No Marks	0.0 pts
Late Submission	0.0 pts Full Marks	0.0 pts No Marks	0.0 pts
Total Points: 100.0			