Tutorial 03: Shadow Mapping

> 💡 **Tip:** It's recommended using the 03_shadow_mapping.html version of this tutorial as copying code works best there regarding padding and formatting.

> **Status:** This tutorial is currently under development.

> ⚠ **Build issues?** See Troubleshooting at the end of this tutorial for help reading build errors from the terminal.

This tutorial will cover implementing shadow mapping to add realistic shadows to your 3D scenes.

Topics to be covered:

- Shadow map rendering from light perspective
- Depth texture creation and sampling
- Shadow bias and peter-panning artifacts
- PCF (Percentage Closer Filtering) for soft shadows
- Integrating shadows into the lighting pipeline

Troubleshooting

Build Failures - Reading Terminal Output

⚠ **Important:** When using `scripts/build.bat`, the task system may report success even if the build actually failed. You **MUST check the terminal output** to see the real result.

What to look for in terminal:

1. Scroll to the **very end** of the terminal output
2. Look for `[SUCCESS] Build completed successfully!` - if this appears, build succeeded
3. If you see `[ERROR] Build failed.` - the build failed regardless of task status

Common build issues:

- **Shader errors** - Check `.wgsl` files for missing semicolons and type mismatches
- **CMake cache issues** - Delete `build/` folder and rebuild clean
- **Include paths** - Verify header includes are correct and files exist

Debug Strategy

If errors are unclear:

1. Open `MeshPass.cpp` in your editor
2. Add a breakpoint in the `render()` method
3. Press `F5` to start debugging with VS Code
4. Check the **Terminal Output** panel - errors will be printed there

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What's Next?

While this tutorial is being developed, continue to **Tutorial 04** to learn about post-processing:

Next Tutorial: 04_postprocessing.md / 04_postprocessing.pdf / 04_postprocessing.html

In Tutorial 04, you'll learn how to write a custom render pass by implementing post-processing effects like vignette, tone mapping, and color grading.