CS 330 Final Project

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**Design Decisions for CS-330 Final Project**

**Overview**  
This scene implements the final-project requirements by combining four low-polygon objects (box, cylinder, torus, sphere), including a composite object assembled from multiple primitives, texture projection on two models, multi-light Phong shading, organized spatial placement, and interactive camera navigation with perspective/orthographic display toggle.

**Object Modeling Choices (Low-Poly, Composite)**  
The 3D scene depicts a mug resting on a coaster placed on a wooden table. The mug is a composite object formed from a cylinder (body) and a torus (handle), demonstrating the requirement for at least one object composed of multiple primitives. The coaster is modeled as a flattened cylinder, while the table is a scaled box forming a large rectangular surface. Transformation functions were used to adjust each object’s scale and placement, so the handle is aligned at the mug’s side, and the coaster is centered beneath it, reflecting the proportions of the reference image and ensuring no overlapping geometry.

**Texture Sourcing and Mapping**  
Two models, the table and the coaster, **use royalty-free seamless textures** with high resolutions. The table applies a rustic wood texture, while the coaster features a stone-like pattern for visual contrast. Both textures were verified for seamless tiling as described in the *Sourcing Textures Tutorial* and use GL\_REPEAT wrapping with linear mipmap filtering to ensure smooth scaling and consistent texel density. The mug body and handle share the same seamless golden ceramic texture, giving the surface a reflective, metallic finish. This texture, combined with the Phong lighting model, enhances highlights and realism across the curved surfaces of the mug.

**Lighting Model and Artistic Intent**  
The lighting setup follows the full Phong model, integrating ambient, diffuse, and specular components to produce realistic shading. Multiple light sources contribute to the composition: a warm directional key light simulates sunlight and defines the primary illumination; a cooler secondary light adds soft reflections and depth; and a gentle front accent light provides subtle balance, preventing harsh shadows. Together, these sources create even illumination across all objects, maintaining detail during camera movement. Specular highlights, controlled by each material’s shininess, enhance the curved geometry of the mug and the textured wood surfaces, reinforcing visual realism and depth.

**Camera Navigation and Nuanced Controls**  
Navigation supports full exploratory movement: **WASD** for planar motion, **Q/E** for vertical translation, **mouse look** for pitch/yaw, and **mouse scroll** to adjust translation speed at runtime. I preserved camera orientation when switching projections so users can reliably compare perspective and orthographic views without disorientation. The projection toggle is bound to a single key for quick A/B visualization of form and proportion.

**Projection Modes (Perspective and Orthographic)**  
A runtime toggle (P) switches between a 45° perspective projection and an orthographic projection with a size calibrated to the dimensions of the scene. The camera’s view matrix is unchanged during the toggle, satisfying the requirement to keep orientation stable. This allows for analysis of spatial relationships: the perspective view enhances depth perception, while the orthographic view aids in verifying proportions and overall layout accuracy.

**World Organization and Spatial Reasoning**  
Objects are placed using explicit XYZ transforms to match the reference layout. I incrementally added objects, verified clear silhouettes from multiple camera angles, and corrected overlaps by adjusting translations and scales. The point light position was chosen to produce readable specular highlights on curved surfaces, while the directional light prevents areas from becoming under-lit during camera traversal.

**Custom Functions and Modularity**  
All additions were made without refactoring existing code. I used an already provided *CreateGLTexture()* function with appropriate wrapping and filtering parameters, and I reused existing mesh draw calls and transform utilities for composition. Uniform setup for lighting and materials is centralized before draw calls to avoid duplication. This keeps the codebase readable, reduces risk to the existing framework, and follows best-practice standards for clarity and functionality.

**User Instructions (Navigation)**

* **Move:** W/A/S/D (forward/left/back/right), Q/E (down/up)
* **Look:** mouse move (pitch/yaw)
* **Speed:** mouse scroll (slower/faster translation)
* **Projection:** press **P** to toggle Perspective ↔ Orthographic

These controls allow inspection of every model and lighting interaction from multiple points.

**Conclusion**

Overall, this project demonstrates the integration of 3D modeling, lighting, and interaction principles in a cohesive scene. By combining technical precision with visual realism, the mug, coaster, and table composition effectively showcases the skills developed throughout the course, achieving both functional interactivity and aesthetic balance.