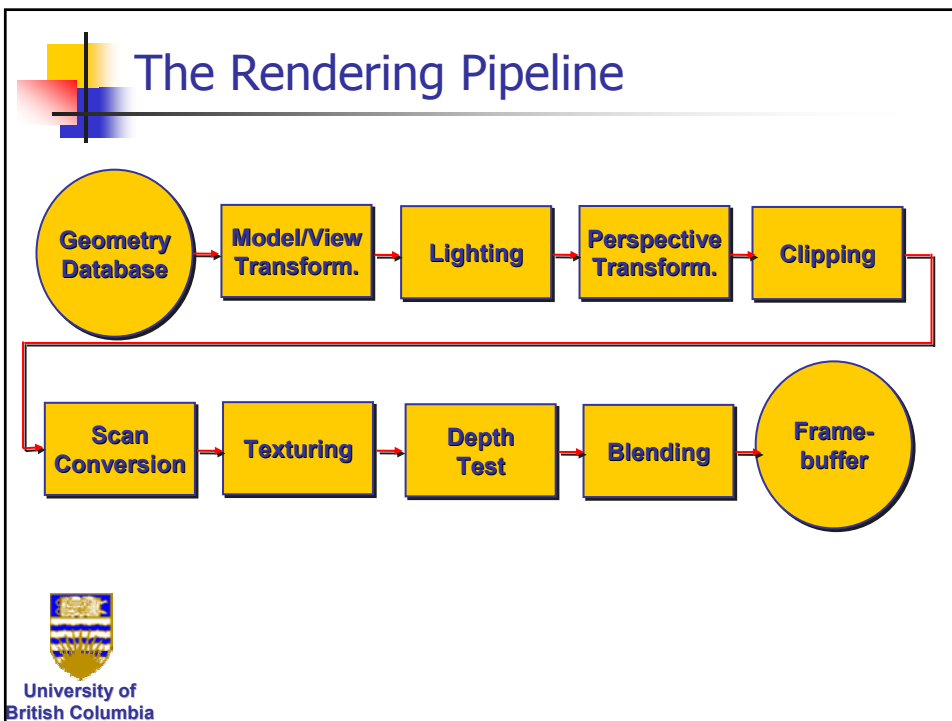





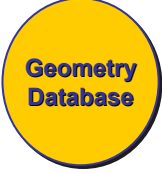
Chapter 2.5

Rendering Pipeline







Geometry Database



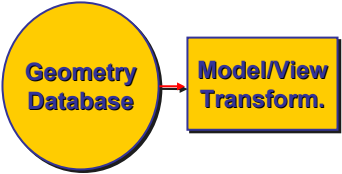
- Geometry database:
 - Application-specific data structure for holding geometric information
 - Depends on specific needs of application
 - Independent triangles, connectivity information etc.




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Model/View Transformation



- Modeling transformation:
 - Map all geometric objects from a local coordinate system into a world coordinate system
- Viewing transformation:
 - Map all geometry from world coordinates into camera coordinates




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Lighting

```
graph LR; A((Geometry Database)) --> B[Model/View Transform.]; B --> C[Lighting]
```

- Lighting:
 - Compute the brightness of every point based on its material properties (e.g. Lambertian diffuse) and the light position(s)
 - Computation is performed *per-vertex*




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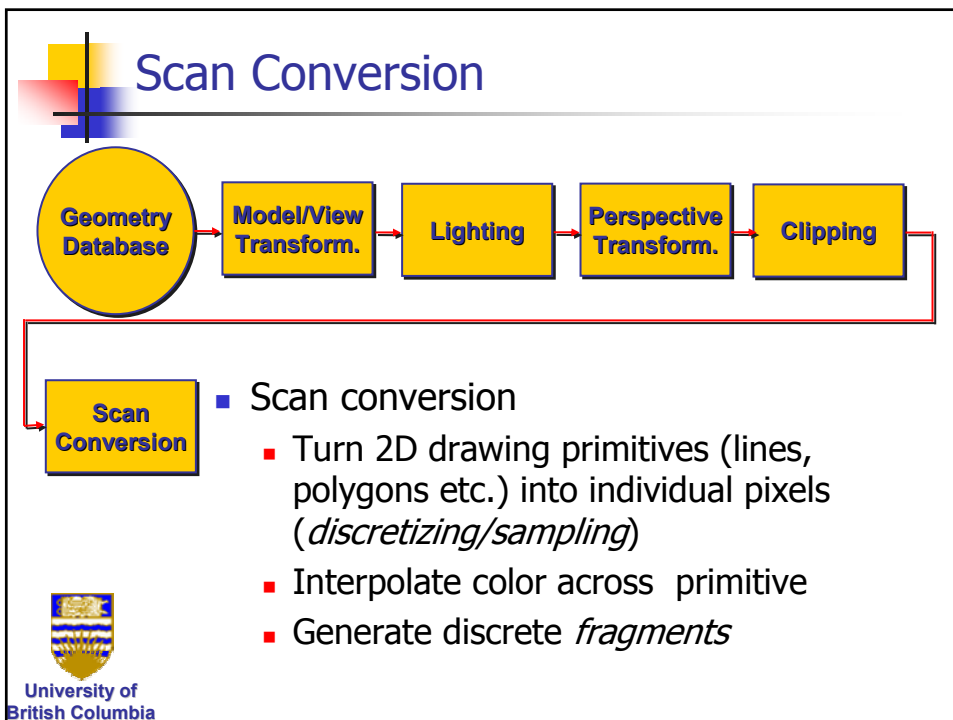
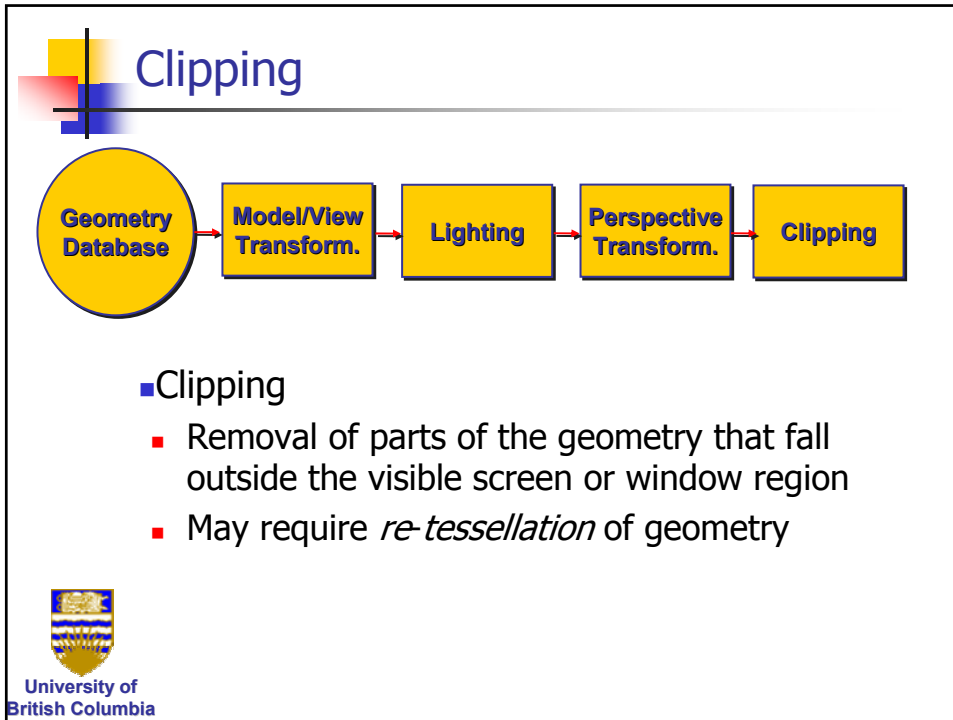
Perspective Transformation

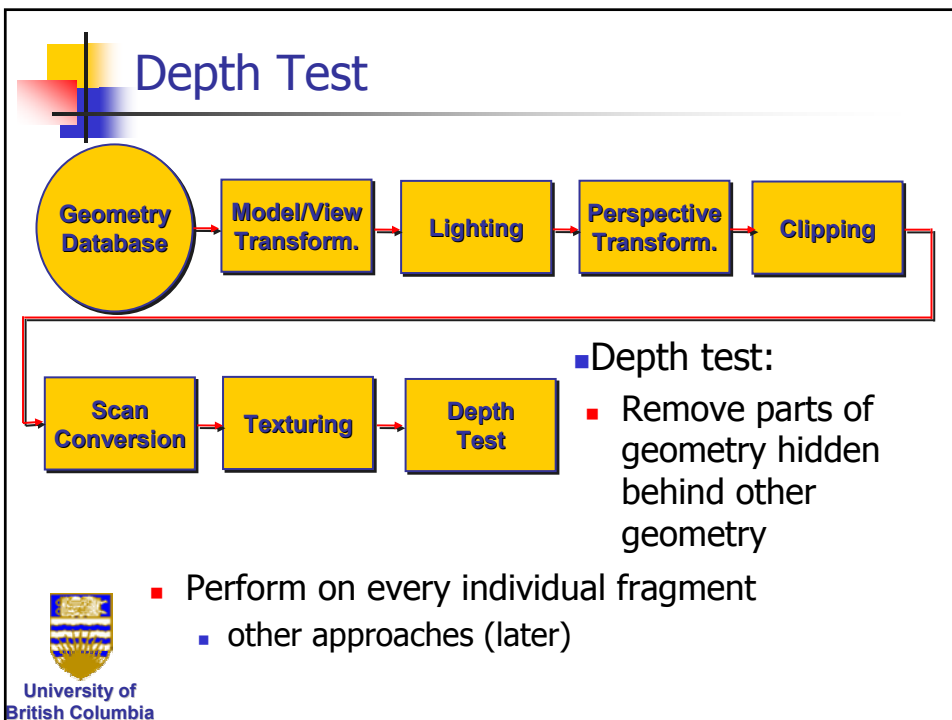
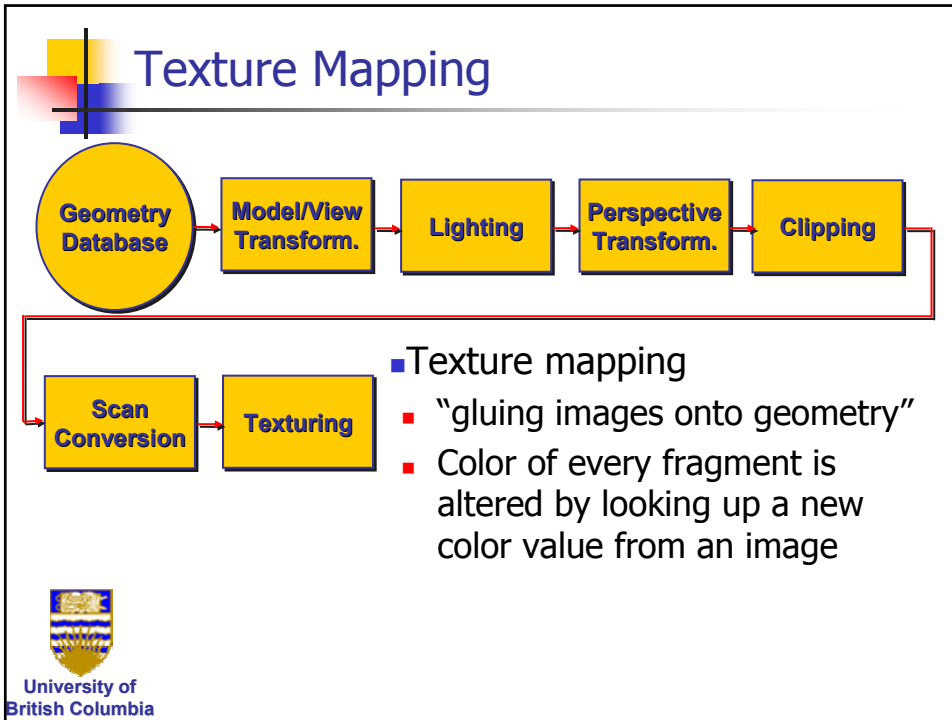
```
graph LR; A((Geometry Database)) --> B[Model/View Transform.]; B --> C[Lighting]; C --> D[Perspective Transform.]
```

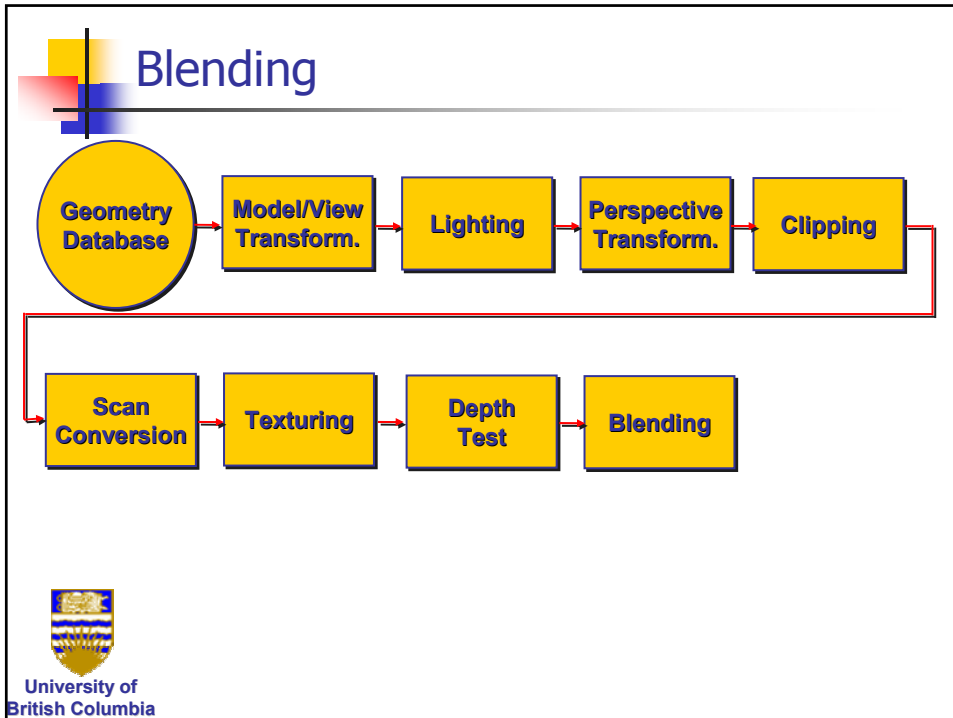
- Perspective transformation
 - Projecting the geometry onto the image plane
 - Projective transformations and model/view transformations can all be expressed with 4x4 matrix operations



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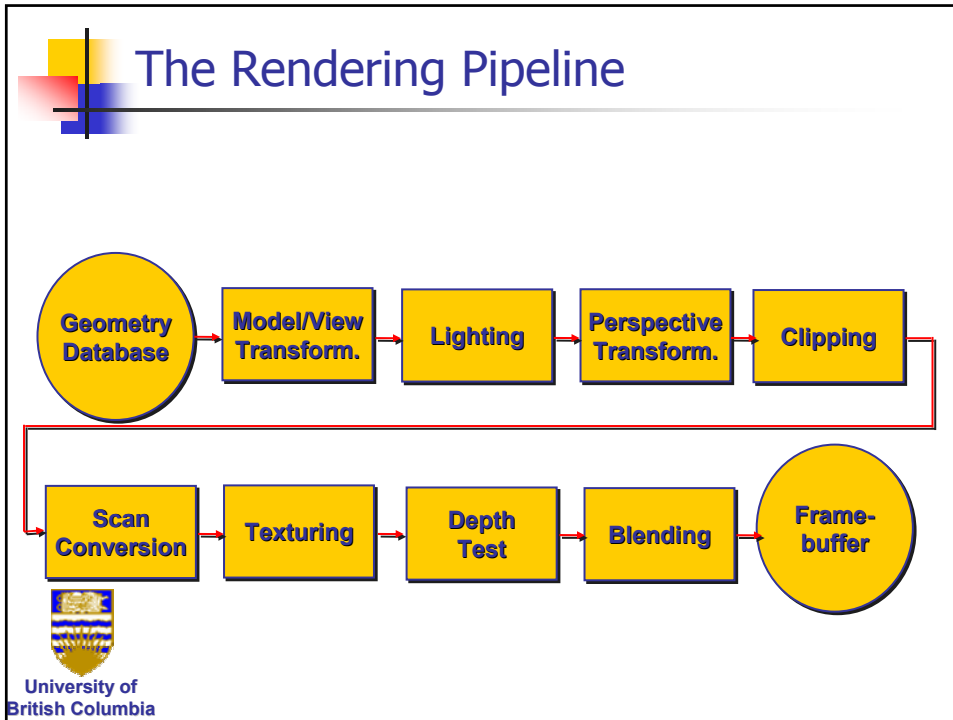




Blending

- Blending:
 - Final image: write fragments to pixels
 - Draw from farthest to nearest
 - No blending – replace previous color
 - Blending: combine new & old values with some arithmetic operations
 - *Framebuffer* : video memory on graphics board that holds resulting image & used to display it

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Discussion

- Advantages of a pipeline structure
 - Logical separation of the different components, modularity
 - Easy to parallelize:
 - Earlier stages can already work on new data while later stages still work with previous data
 - Similar to pipelining in modern CPUs
 - But much more aggressive parallelization possible (special purpose hardware!)
 - Important for hardware implementations!
 - Only local knowledge of the scene is necessary

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Discussion

- Disadvantages:
 - Limited flexibility
 - Some algorithms would require different ordering of pipeline stages
 - Hard to achieve while still preserving compatibility
 - Only local knowledge of scene is available
 - Shadows
 - Global illumination



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