1 Shadow Techniques [ /7]

For each shadow algorithm below, check the boxes to indicate the features and limitations inherent in the technique. The features and limitations may be used more than once.

<table>
<thead>
<tr>
<th>Features / Limitations</th>
<th>Planar Fake Shadows</th>
<th>Projective Texture Shadows</th>
<th>Shadow Maps</th>
<th>Shadow Volumes</th>
<th>Ray Casting Shadows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allows objects to cast shadows on themselves (self shadowing)</td>
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<tr>
<td>Permits shadows on arbitrary surfaces (i.e., curved)</td>
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<tr>
<td>Renders geometry from the viewpoint of the light</td>
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<tr>
<td>Generates extra geometric primitives</td>
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<tr>
<td>Limited resolution of intermediate representation can result in jaggy shadow artifacts</td>
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</tbody>
</table>
2 Radiosity / Ray Tracing

2.1 Precomputation

Radiosity is a multi-step algorithm: 1) divide scene into patches, 2) compute form factors, 3) solve radiosity matrix, 4) render the image. Fortunately, much of the work can be performed as a precomputation and may be reused. For each of the scenarios below indicate which steps must be redone and relatively how expensive the change will be:

<table>
<thead>
<tr>
<th>Change the camera position</th>
<th>steps to be redone</th>
<th>relative cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change the light position (which patch emits light)</td>
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<tr>
<td>Change the total energy emitted by the light source</td>
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<tr>
<td>Add a light source</td>
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<td></td>
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<tr>
<td>Change the color of one of the walls</td>
<td></td>
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<tr>
<td>Move an object within the scene</td>
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<td></td>
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<tr>
<td>Add an object</td>
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</tbody>
</table>

2.2 Distribution Ray Tracing

Describe how to extend a traditional ray tracer with motion blur, an effect seen in film images when an object moves fast relative to the shutter speed.
2.3  **Forward Illumination** [ /2]
Circle each of the following algorithms that track light as it leaves the light source and travels throughout the scene:

- ray casting
- Monte Carlo ray tracing
- distribution ray tracing
- ray tracing
- path tracing
- irradiance caching
- radiosity
- bidirectional path tracing
- photon mapping

2.4  **Caustics** [ /2]
Circle each of the following algorithms that will create an optically correct rendering of the caustic formed in a scene with an ant, a magnifying glass, and the sun.

- ray casting
- Monte Carlo ray tracing
- distribution ray tracing
- ray tracing
- path tracing
- irradiance caching
- radiosity
- bidirectional path tracing
- photon mapping

2.5  **Participating Media** [ /4]
Describe a scene in which subsurface or atmospheric scattering is important and summarize a rendering technique that may be used simulate that behavior.
3 Potpourri

3.1 Sampling

Describe how to generate points uniformly at random on the edge of a circle of radius $r$ centered at the origin in the $xy$-plane.

3.2 Texture Synthesis

What parameters control the running time of the texture synthesis method by Efros & Leung? Write the formula for the order notation for the running time in terms of these variables.
3.3 Temporal Dimension

When rendering the frames of an animation using a technique such as “Interactive Pen-and-Ink Illustration” by Salisbury et al., what artifact(s) are likely to appear?

How do Meyer & Anderson minimize the appearance of a similar problem in “Statistical Acceleration for Animated Global Illumination”?

3.4 Anyone Got Scissors?

Draw heavy lines to indicate cut lines on this 3D L-shaped closed box so that it can be unfolded into a single flat shape with no overlaps (papercraft style) or prove that it is impossible to do so.
4 Truthiness [ /8]

Most of the statements below are false. Identify each statement as false or true, and correct each false statement so that it is true (but still informative).

4.1 Ambient Illumination [ /2]

True or False  The ambient term of the Phong BRDF is a hack to approximate color bleeding.

4.2 Procedural Textures [ /2]

True or False  Ken Perlin (who is a good rapper) won an Oscar for his noise because it is fast, deterministic, looks random, and can be used to make fake marble.

4.3 Image Analogies [ /2]

True or False  “Image Analogies” by Hertzmann et al. can only be used to imitate the style of master artists who painted from photographs because it is necessary to have both A and A’.

4.4 Photo Pop-up [ /2]

True or False  “Automatic Photo Pop-up” by Hoiem et al. does not work for natural scenes and can only be applied to man-made geometry such as indoor architectural photographs.