CS 190I Final project

Logistics

- Work by yourself, no group.
- Due on Mar 19, 2024, 23:59.
- Your merit days are no longer available in the final project.
- Report your name and topic before Mar 3, 2024 in this Google Doc
- You can propose your own topic. If you are going to do so, you need to send an email **early** to the professor and the TA to discuss the idea and get approval from the professor.
- No neural networks (only allowed for denoising), no inverse rendering, and no differentiable rendering.
- Submit a short final report, as well as the final rendering result. The final rendering results are required to have a resolution of no less than 1080 x 720. Some projects might require video. The report should include a short description of your project, including the code skeleton you use, the scene, and which functions you implemented.

Grading (total of 100 points)

- Difficulty: 30
- Completeness & Correctness: 60
- Aesthetics: 10

Your final points are not just based on the criteria listed above. You don't necessarily have to choose a topic with the highest difficulty and implement it perfectly to achieve 100 points.
For example, a simple topic with good implementation and presented well can also receive 100 points. Meanwhile, a challenging topic, even if not perfectly implemented, can still earn full points.

Example Topics

1. Photon Mapping (diff: 20/30)
    a. Basic requirements
        i. Kd-tree (20/60)
        ii. Caustics (must have more than 1 transmittance object in the scene) (30/60)
        iii. The scene can be as easy as a Cornell box (10/60)
    b. References
        i. https://www.pbr-book.org/3ed-2018/Light_Transport_III_Bidirectional_Methods/Stochastic_Progressive_Photon_Mapping#PhotonMapping
        ii. http://graphics.ucsd.edu/~henrik/papers/photon_map/

2. Progressive Photon Mapping (diff: 30/30)
    a. Basic requirements
        i. Kd_tree (20/60)
        ii. Caustics (must have more than 1 transmittance object in the scene) (30/60)
        iii. The scene can be as easy as Cornell box (10/60)
    b. References
        i. https://www.pbr-book.org/3ed-2018/Light_Transport_III_Bidirectional_Methods/Stochastic_Progressive_Photon_Mapping#x2-ProgressivePhotonMapping
        ii. http://graphics.ucsd.edu/~henrik/papers/progressive_photon_mapping/progressive_photon_mapping.pdf

3. Dielectric Microfacet BSDF (diff: 25/30)
    a. Basic requirements
        i. eval() and pdf() (20/60)
        ii. GGX (10/60)
        iii. Importance sampling() (20/60)
        iv. Must have at least a rough transmittance object in the scene (10/60)
    b. References
        i. https://www.pbr-book.org/3ed-2018/Reflection_Models/Specular_Reflection_and_Transmission#SpecularTransmission
        ii. https://www.cs.cornell.edu/~srm/publications/EGSR07-btdf.pdf

4. Hair BCSDF with Marschner model (diff: 30/30)
    a. Basic requirements
        i. Use Embree (10/60)
        ii. Implement BCSDF in Embree (40/60)
        iii. No importance sampling required
        iv. The hair model can be found here: https://benedikt-bitterli.me/resources/ (10/60)
    b. References
        i. http://www.graphics.stanford.edu/papers/hair/hair-sg03final.pdf
        ii. https://dl.acm.org/doi/10.1111/j.1467-8659.2011.01976.x

5. **Real-time** 4D Lightfield Camera Demo (diff: 20/30)
    a. Basic requirements
        i. 4D lightfield, you can find dataset here: https://lightfield-analysis.uni-konstanz.de/ (10/60)
        ii. Lightfield query (30/60)
        iii. Depth of field (10/60)

iv. Show depth of field. Video required. Record your real-time demo using screen recording software like OBS (10/60)

b. References
   i. https://www.pbr-book.org/3ed-2018/Camera_Models/Projective_Camera_Models#fragment-Initializedepthoffieldparameters-0
   ii. https://graphics.stanford.edu/talks/lightfields-uncc-10jun08-public.pdf

6. Homogeneous Medium (diff: 25/30)
   a. Basic requirements
      i. Homogeneous medium rendering using delta tracking(50/60)
      ii. Use a scene with volume, the scene can be found here: https://benedikt-bitterli.me/resources/ (10/60)
   b. References
      i. https://www.pbr-book.org/3ed-2018/Volume_Scattering/Volume_Scattering_Processes
      ii. https://www.pbr-book.org/3ed-2018/Volume_Scattering/Phase_Functions
      iii. https://www.pbr-book.org/3ed-2018/Volume_Scattering/Media

7. Cloth rendering (diff: 20/30)
   a. Basic requirements
      i. Implement Cloth BRDF (40/60)
      ii. Rendering results with cloth mesh (no simulation required) (20/60)
   b. References
      i. http://sadeghi.com/a-practical-microcylinder-appearance-model-for-cloth-rendering/

8. Optix Disney Principled Materials (diff: 15/30)
   a. Basic requirements
      i. Work with Optix (you need to have an NVIDIA RTX GPU) or Falcor (20/60)
      ii. Implement Disney principled materials in Optix or Falcor. You only need to implement 3 parameters. (30/60)
      iii. You do not need to have complicated scenes. No UI. Show all parameters in the results. (10/60)
   b. References
      i. https://media.disneyanimation.com/uploads/production/publication_asset/48/asset/s2012_pbs_disney_brdf_notes_v3.pdf
      ii. https://github.com/mmp/pbrt-v3/blob/master/src/materials/disney.cpp