# Assignment 5: Video Animation

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## Video Information

- Frame rate: 24fps

- Duration: 20sec

- Resolution: 1080 x 1080 pixels

- Description: This video is showing a pool game located in a castle room. It is rendered frame by frame based on the A4 ray tracing framework. (Since the motion blur and depth of field effects makes the background blurry and a higher sample rate is required, they are only turned on for the first 5 seconds)

## Features Implemented & Technical details

1. Texture mapping:
   Mapping the png images on the surface of balls, cubes and meshes. Supports looping textures on meshes.

2. Two or more geometric primitives interacting with each other without space overlap:
   A basic physics engine is implemented to calculate the elastic collision between balls and trace the velocity.

3. Depth of field:
   The pin-hole camera model is replaced by simulating a single thin lens camera model. The thin lens approximation is used here, that the ray is directly cast from the lens to the focus plane [1]. The defocus blur can be observed at the near objects and far backgrounds that the camera is not focusing on during the 1-5sec of the video.

4. Motion blur:
   The moving balls are assigned to a random location between the absolute locations of the ball at the current frame and the next frame [1]. The motion blur can be observed at the moving balls at different velocities during the 1-5sec of the video.

5. Shadows:
   The shadows are implemented by shadow rays; they can be observed under each ball.

6. Sound (synchronized with action):
   Sound effects and background music are added in the video editing software (Final Cut

Pro).

## Extra Features for the Aesthetics

1. Mirror reflection:
   Implemented as extra objective in A4.

2. Refraction:
   Implemented by Snell's Law and Fresnel Effect.

3. Panoramic background:
   Project a panoramic image as background, similar to the texture mapping.

## Sources of Assets

1. The panoramic background images (castle2k.png, bar2k.png) are rendered by myself in the game Minecraft. The map is created by myself, the tools used for rendering these images are: Replay Mod; SEUS PTGI E12 Shader.

2. The billiard ball textures (blueball.png, redball.png) are shared for free from sharecg.com, the links are as below:
   https://www.sharecg.com/v/12975/Texture/Billiard-Ball---N%20-10
   https://www.sharecg.com/v/12968/texture/billiard-ball---n%B0-3

3. The billiard table textures (wood1.png, wood2.png, cloth.png) are shared for free from downloadfree3d.com, the link is below:
   https://downloadfree3d.com/interior/furniture/table/table-billiard/

4. The sounds of the billiard ball hit added in the video are shared for free on the website freesound.com, the links are here:
   https://freesound.org/people/cameronmusic/sounds/138401/
   https://freesound.org/people/jrhodesza/sounds/367147/
   https://freesound.org/people/reg7783/sounds/204187/

## References

[1] Shirley, P. (2020, December 7). *Ray Tracing in One Weekend*. Ray tracing in one weekend series. https://raytracing.github.io/books/RayTracingInOneWeekend.html.