

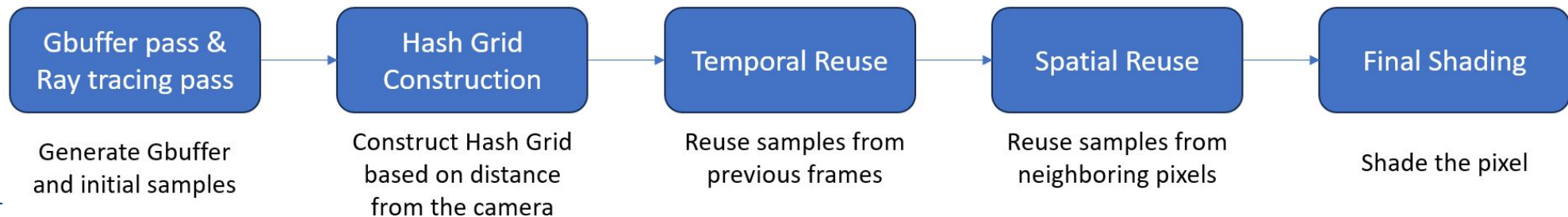
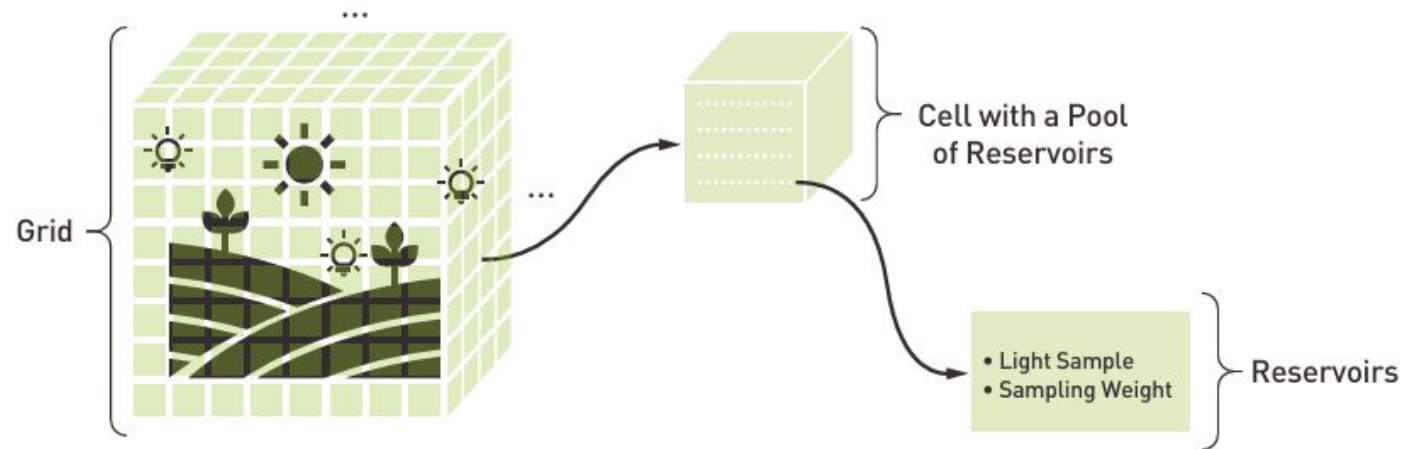


World Space ReSTIR in Vulkan

Jichu Mao Zhiyi Zhou
CIS 5650 - Final Project
Milestone II

Recall

- **Goal:** Implement a real-time global illumination renderer based on world-space ReSTIR in Vulkan



Progress

Milestone 1 (Nov 04 - 13)

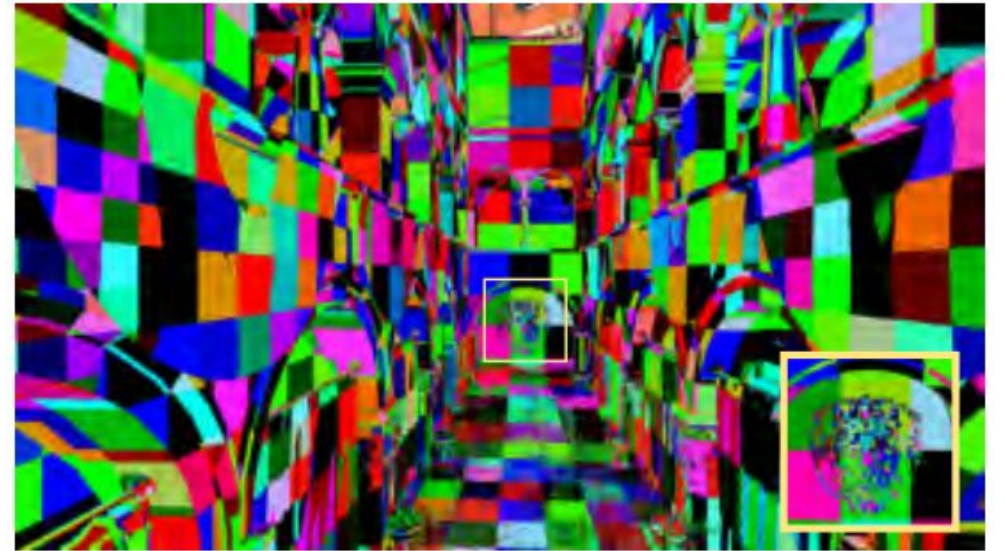
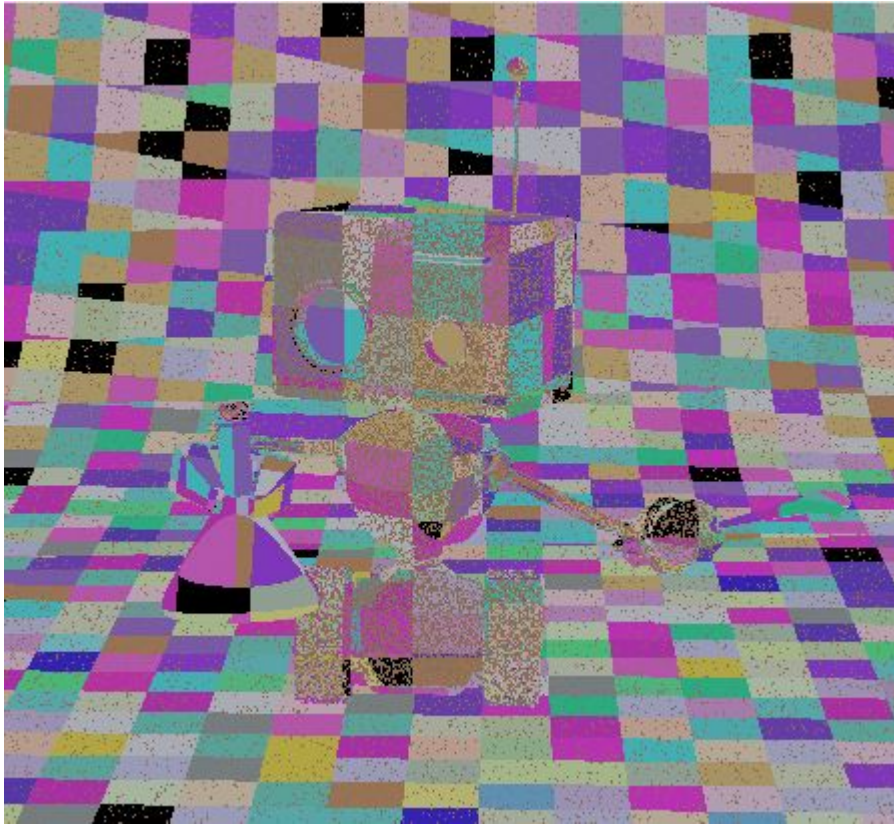
- Basic Vulkan Ray-Tracing Pipeline Setup
- Hash Grid Data Structure Setup
- Research on RIS, Reservoir-based sample Algorithm and Denoise techs

Milestone 2 (Nov 13 - 25)

- Completed hash grid Construction & Visualization
- Partly completed temporal Reuse
- Completed World Space ReSTIR DI
- Completed basic Denoiser integration (need to be improved)

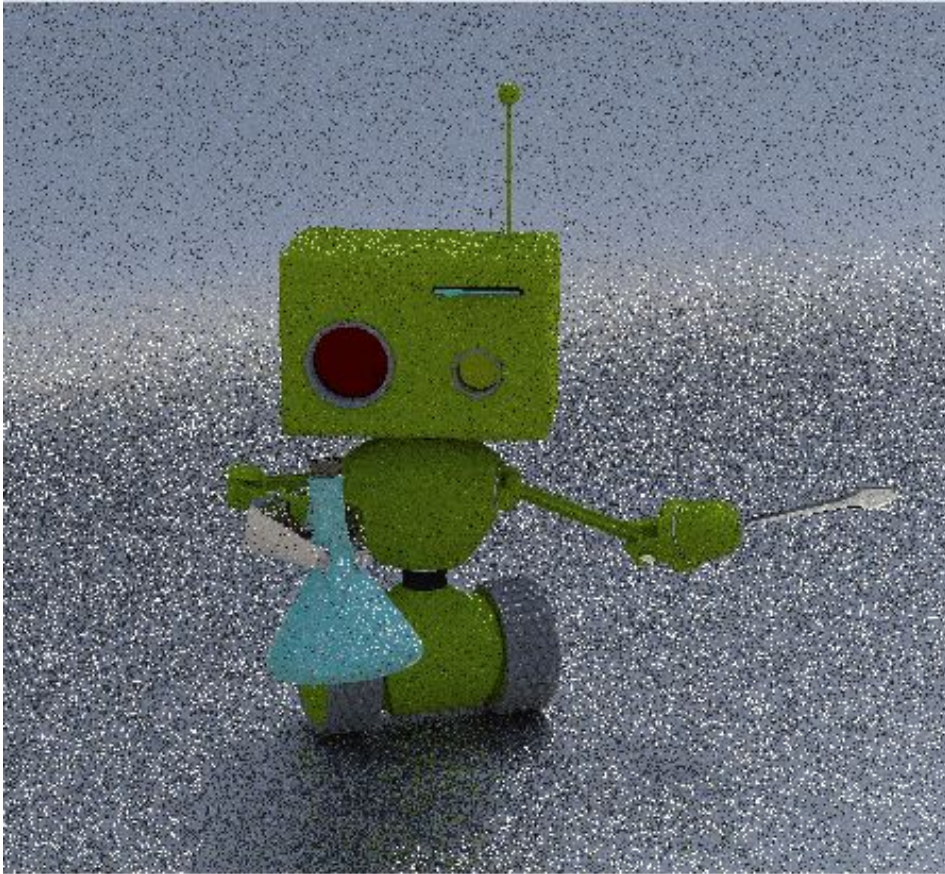
M2 Progress

- Hash Grid Construction & Visualization

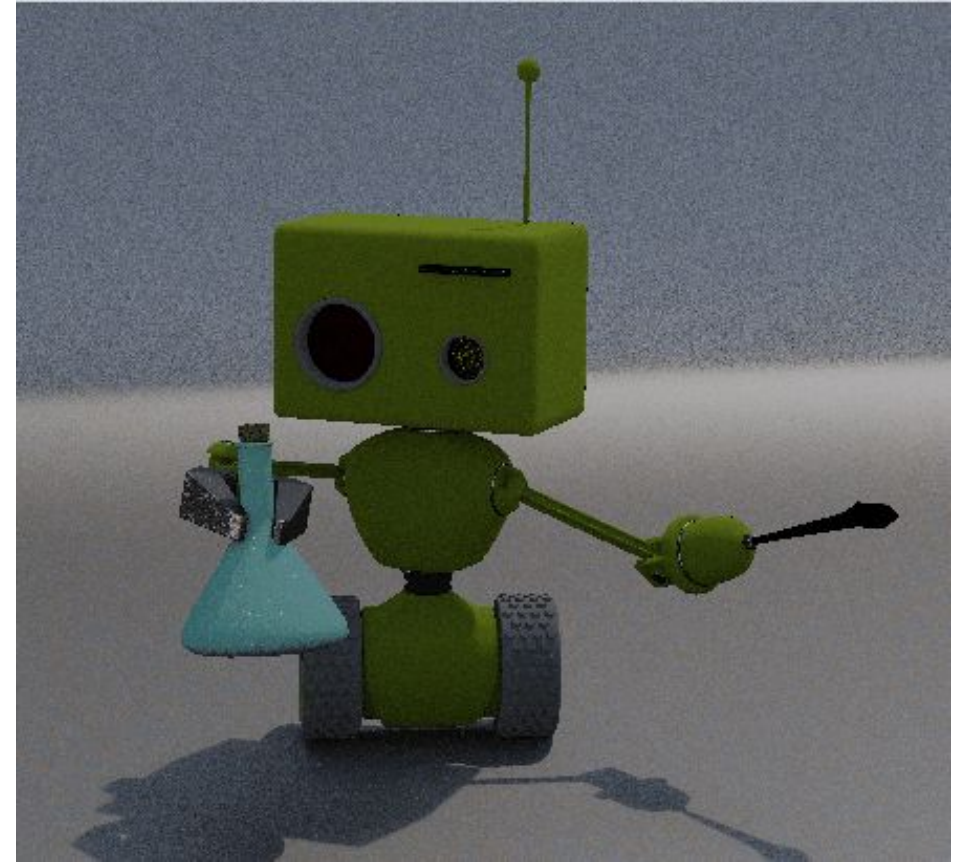


M2 Progress

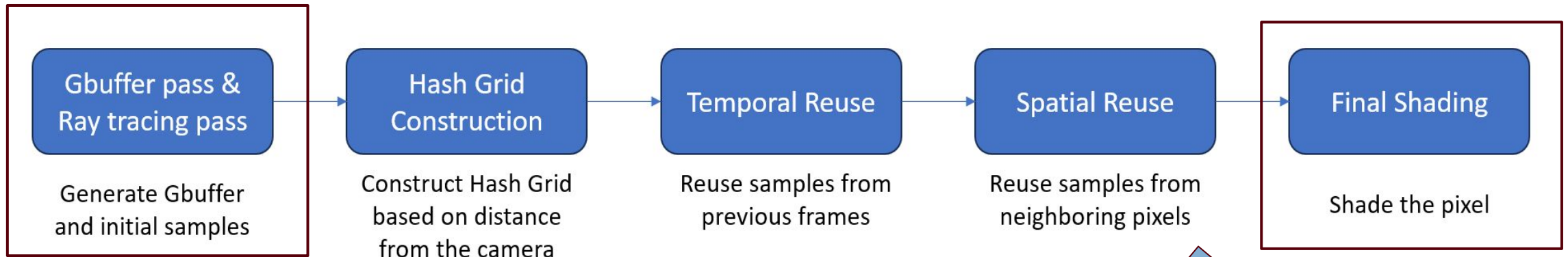
- Temporal Reuse



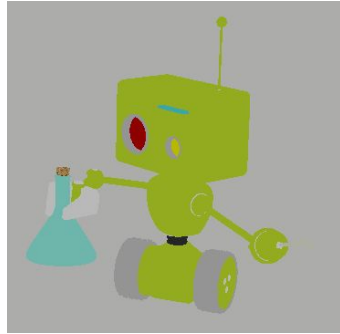
- World Space ReSTIR DI



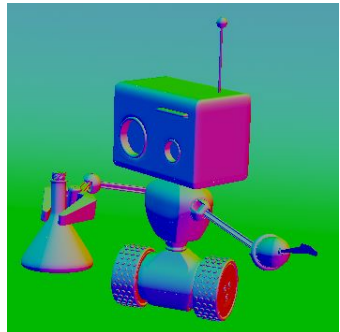
Denoise Process



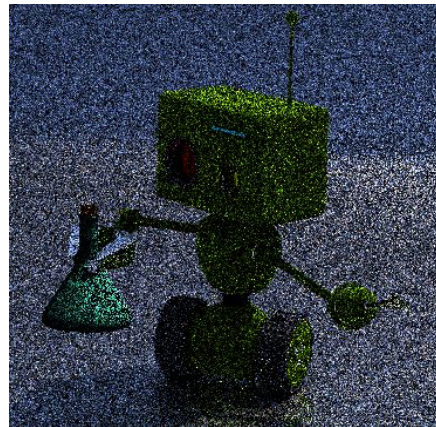
• Albedo



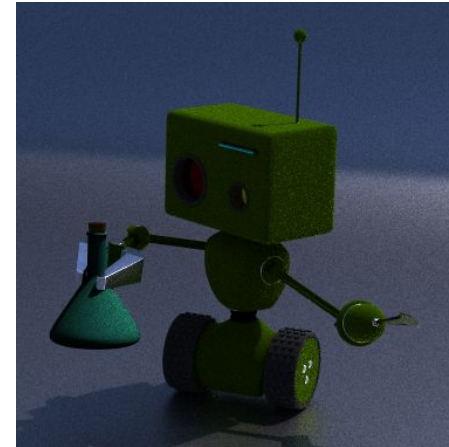
• Normal



Color

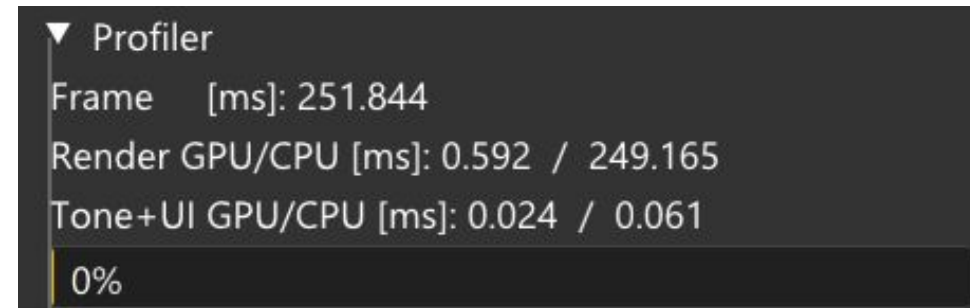
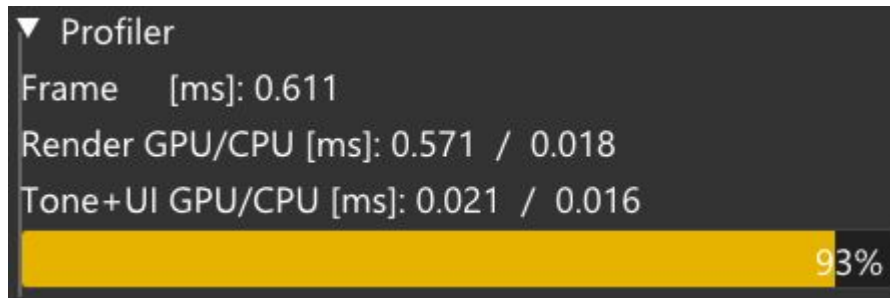


Denoise



Difficulties

- **Integration of Denoiser:** Challenging to integrate into the vulkan pipeline if you want to do it efficiently
- **Resource Management:** A deep understanding of Vulkan is crucial

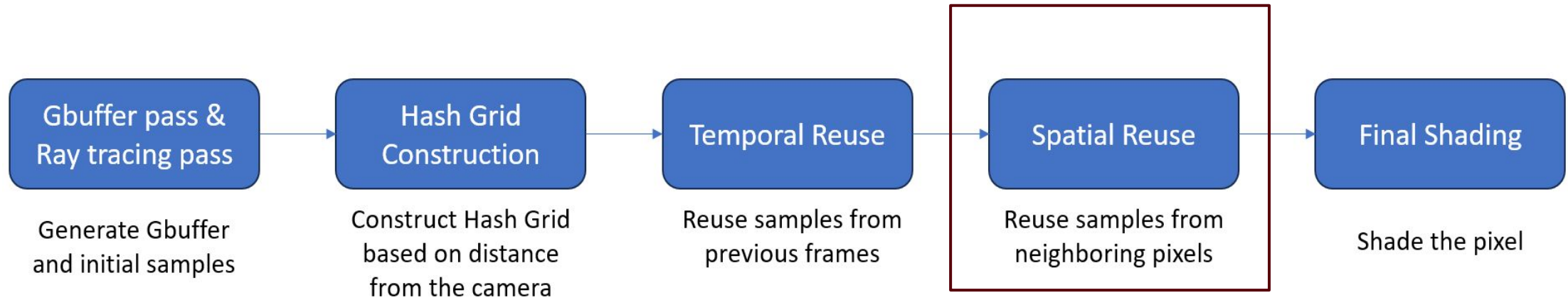
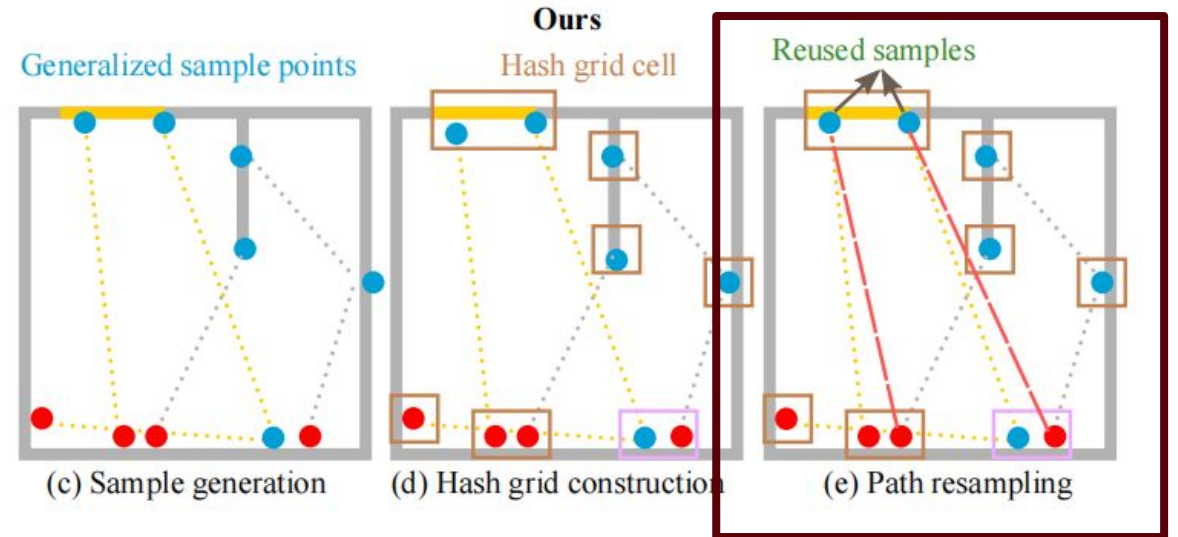


Low FPS after applied Denoiser
(OIDN execute() function takes ~250ms for High Quality)

Next Step

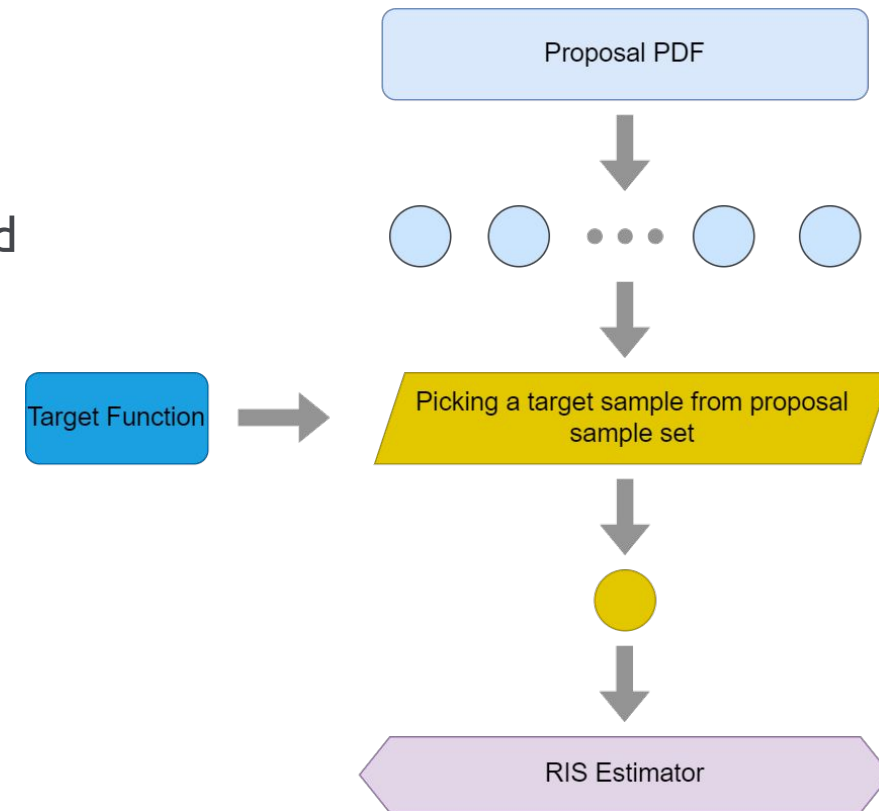
Plan for Milestone 3 (Nov 25 - Dec 2)

- Start to complete spatial reuse
- Fix bugs for temporal reuse
- Optimize resource management for Denoiser



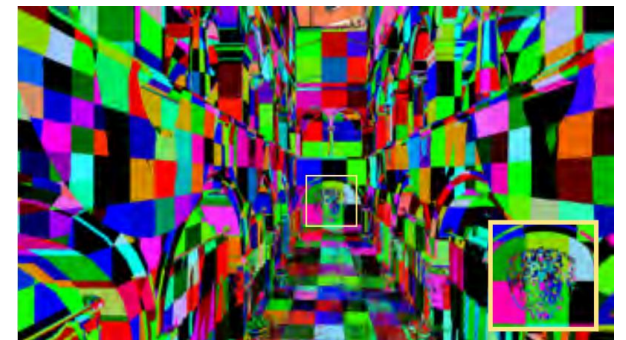
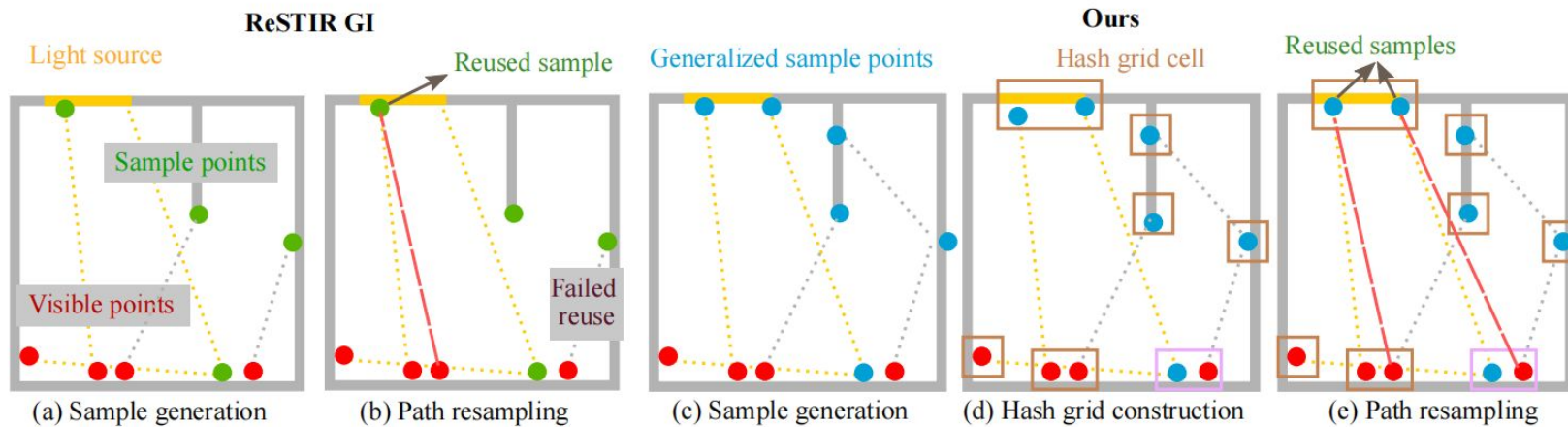
ReSTIR

- RIS: Resampled importance sampling. Draw n samples from a proposal distribution and select one based on a weighting function. This approach is progressively unbiased as n approaches infinity.
- WIS: Weighted Reservoir Sampling. The reservoir efficiently stores and manages samples without requiring all of them to remain in memory (we only need some statistical properties).
- Temporal / Spatial reuse: Reuse samples from neighboring pixels and previous frames, reservoir structure can help us to combine different reservoirs from different pixels and frames.



Paper

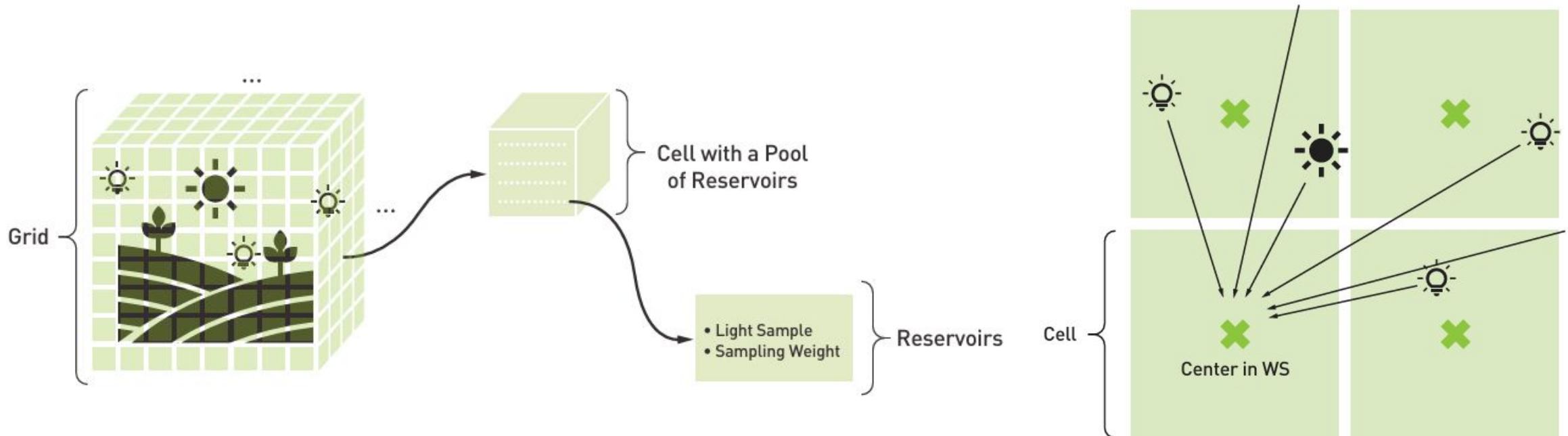
- Pure **ReSTIR GI** Operates in **screen space**. It optimizes global illumination sampling for primary rays and uses spatiotemporal resampling to manage indirect illumination. The reservoirs are tied to **screen-space pixels**.
- We extend it to **world space**. It divides the scene into a **3D grid**, with reservoirs distributed across these grid cells.
- To construct the grid, we use a hash function based on the world position and surface normal to map these cells, allowing us to locate sample points with similar geometric properties.



Overview

What is GRID-BASED RESERVOIRS(ReGIR)?

ReGIR (Reservoir Grid Importance Resampling) is an algorithm designed for **efficiently rendering scenes with many light sources** in real-time ray tracing. It builds upon existing techniques such as ReSTIR (Reservoir Spatiotemporal Importance Resampling) and applies them to world-space sampling using a grid-based structure to optimize light sampling for secondary rays.



Milestone Presentations – Do

- Strictly *stick to time limits* – N minutes is $N \times 60$ seconds!
 - Default length will be 5 minutes, but may change – Will be posted on Ed Discussion
- **Show progress since last milestone**
- Videos, screenshots and demos
- Include goals for next milestone
- Know your audience
 - i.e. your fellow students, not the instructor or TAs
- Add presentation to your GitHub repo.

Milestone Presentations – Do

- Use social media – Great time to show off your work
- Get in touch with original authors – They really like it
 - And do this earlier than later
- See the Cesium [Presenter's Guide](#) (or your favorite company) for tips on presenting
- Be sure to present as a team; for a great example, see <http://www.youtube.com/watch?v=OTCuYzAw31>

Milestone Presentations – Don't

Doing any of these may result in grade penalties

- Don't exceed time limits for presentations
- Don't include code/math equations in your presentation
 - Exceptions: Something cool, good to know, or required for another part of your presentation.
 - If you need to walkthrough the code/math, don't include it