Project Ideas

Broader Domains: Computer Graphics, CUDA and Compilers

Real-time Ray Tracing and Global Illumination on GPUs

This project could explore techniques for achieving real-time ray tracing, a highly accurate method of rendering realistic lighting in computer graphics, on GPUs using NVIDIA CUDA. Ray tracing is a rendering technique that simulates the behaviour of light as it travels through a scene, tracing the path of each light ray from the camera to the objects in the scene and back to the camera. This process can be computationally expensive, especially for complex scenes with many light sources and reflective surfaces, which is why real-time ray tracing on GPUs is an important area of research. The project could compare different algorithms for rendering, as well as explore optimizations for parallelization on GPUs.

Designing a Domain-Specific Language (DSL) for GPU Programming

This project could involve creating a new programming language designed specifically for GPU programming using NVIDIA CUDA. The language could include features that allow for easier expression of parallelism, such as automatic generation of thread blocks and warps, and optimized memory management. Domains are yet to be explored for this area.

Compiler Optimizations for Heterogeneous Systems

This project could explore techniques for optimizing code for heterogeneous systems that include both CPUs and GPUs. The project could focus on developing compiler optimizations that automatically offload compute-intensive portions of code to the GPU, while keeping the rest of the code running on the CPU. Maintaining CPU and GPU execution workload.

Automatic Code Generation for NVIDIA CUDA

This project could explore developing a compiler that could involve developing tools for automatically generating NVIDIA CUDA code from higher-level specifications. The project could explore techniques for generating code that is both efficient and easy to write and maintain, and could also investigate the use of machine learning techniques for optimizing code generation.