CUDA
- Computer Unified Device Architecture
- Extension of C
- Programming on Graphical Processing Units (GPUs)
- Thousands of computations in parallel
- More than graphical computations

Passing the Torch
- Today, CPUs are the primary computational units
- Single Instruction Multiple Data (SIMD) ideal for parallelization
- Graphical Rendering
- Biological Computation
- Genetics
- Database Operations
- Push towards parallelized systems and algorithms

Future Work
- Creation of a full Benchmark Suite
- Performance Analysis on various GPUs
- Further parallelization of Micro-Benchmark Kernels
- Thermal Imaging GPUs under different loads
- Performance Ranges within Benchmarks

Making the Most of your Hardware

Micro-Benchmarks on NVIDIA GPUs

Ian Lee, UConn
Jose Renau, UCSC
Javi Mahai, UCSC

Digits of Pi
- Computation of Pi has been explored for thousands of years
- Many algorithms and methods of computing
- Gregory-Leibniz Series computes whole value of Pi, rather than digits
- CPU takes ~1 second perform same calculation

Bus Bandwidth
- Computation on the GPU requires data to be transferred to the device
- Limited by hardware transfer rates
- Average Bandwidth varies by transfer direction
- Outlying cases vary by model of GPU

Scalar Multiplication of Vectors
- Current CPU Benchmarks adaptable to GPU
- Scalar Alpha X Plus Y (SAXPY) of Single Precision Floats
  - \( \alpha X + Y \)
  - Pseudo Randomly generated vectors X and Y, as well as scalar \( \alpha \)
  - Comparisons between GPUs

GPU Memory Access
- Read, Write, and Copy are most common
- GPU Architecture modeled after CPU
- Global Memory
  - Like Primary Memory in CPU Architecture
  - 256 – 1024 MB on Modern GPUs
- Shared Memory
  - Similar to Cache of CPUs
  - Typically 16 KB per Streaming Multi-Processor (SM)
  - 112 – 192 SMs per GPU

Making the Most of Database Operations
- Push towards parallelized systems and algorithms

GPU Memory Access
- Read/Write Benchmark: Bandwidth
- Global memory
- Shared memory

Bus Bandwidth
- Data Transfer Rates (Host-Device)
- GeForce 9800 GT vs 9800 GTX