Cheat Detection Processing: A GPU versus CPU Comparison

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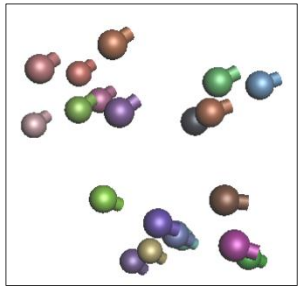
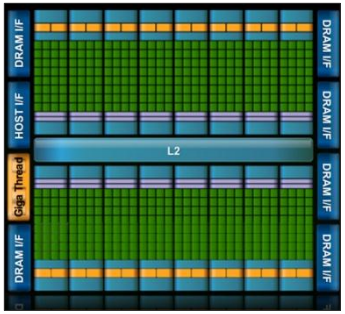
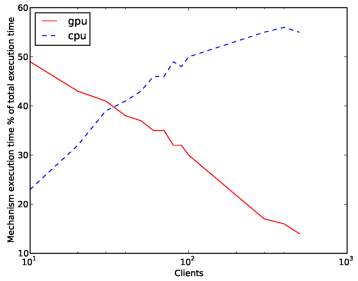
This presentation will give an introduction to local cheat detection processing using GPUs.



Cheat Detection and our example game



Nvidia Graphics Processing Units



Results and Conclusion

Cheating in computer games

- Multi-player gaming has experienced an amazing growth over the last decade, and cheating is the most prominent case of malicious behavior.
- Many on-line multi-player games still suffer from excessive cheating in one form or another. In many cases, the existence of the cheating is hard to prove.
- Most games that have implemented in-game physics use it as a major part of the game-play. In-game physics is therefore a very likely part of a game to be exploited.
- Our goal in this paper is to determine if graphics processing units (GPUs) can offload cheat detection mechanisms in a client-server based game system.

Classification of Cheats

Game level cheats:

- Breaking rules in the game and misusing features
- No modifications to the game client needed

Application level cheats:

- Modifications to game client or the operating system
- Example: Aimbots, reflex enhancers and farming bots

Protocol level cheats:

- Changing or delaying contents of packets
- Will appear only as high latency to other players and the central server

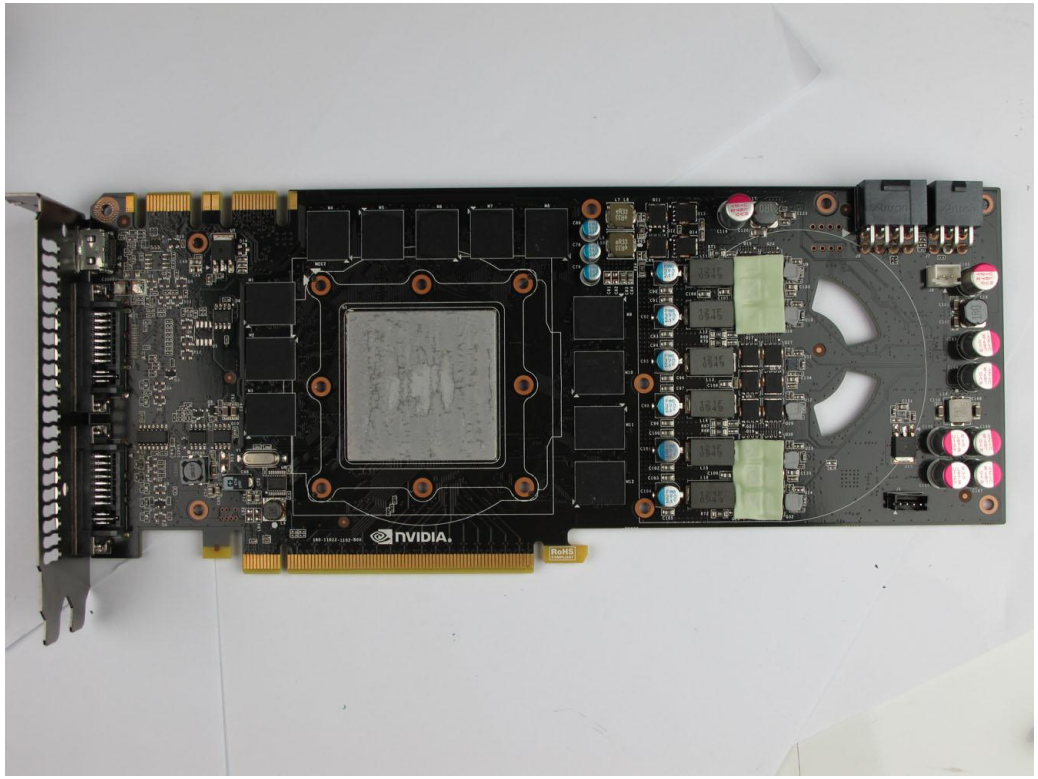
Infrastructure level cheats:

- Modifications to drivers, libraries, hardware, network etc.
- Example: Don’t render textures, and see through objects

Existing Cheat Detection Mechanisms

- **Most existing solutions run on the client side:**
  - Applications running on the client-side are also a likely target for exploits.
- **Deployed Detection Mechanisms:**
  - **VAC:** Valve Anti-Cheat is integrated in Steam. Can not detect content hacks, i.e. transparent textures used by the driver.
  - **Punkbuster:** 3rd party tool which search memory on the client side for known exploits using signatures.
  - **Warden:** Developed by Blizzard. Scans the Warcraft game memory space. Can also search out-of-process for known cheating drivers.

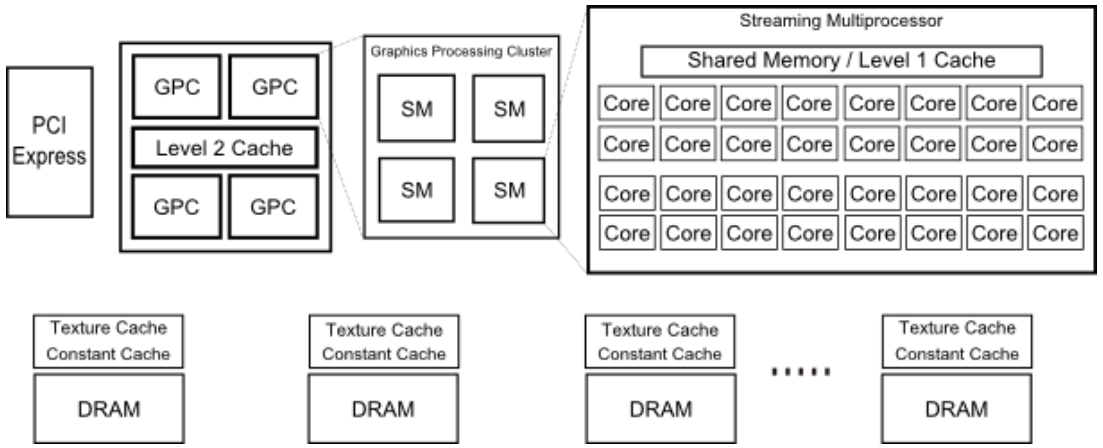
Nvidia GeForce Graphics Processors



- Nvidia GeForce GTX 480
- Based on the latest generation GPU, codenamed GF100 (Fermi)
- 3 billion transistors on TSMC 40nm (Made in Taiwan ☺)
- 480 Processing cores (CUDA Cores) at 1401 MHz
- 1536 MB Memory with 177,4 GB/sec of bandwidth.
- 1344.96 GFLOPS (FMA) of computing power

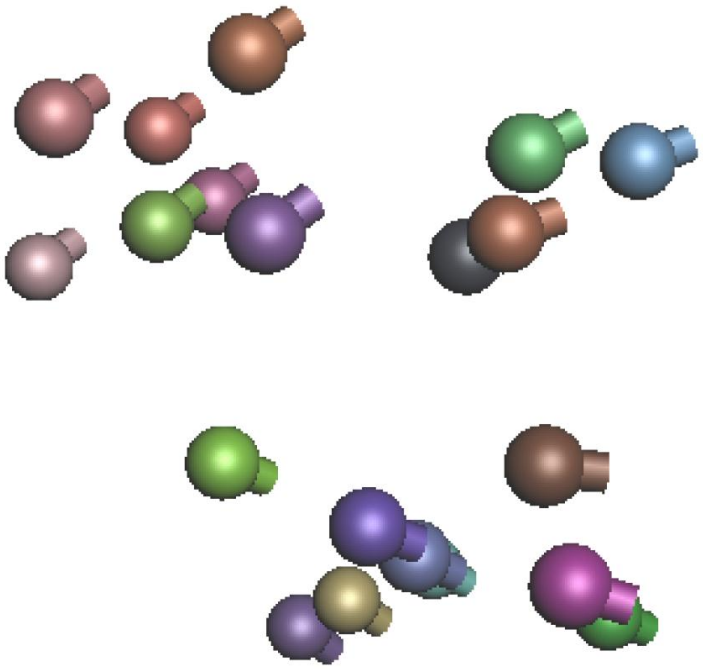
Nvidia GeForce GF100 Graphics Processing Unit Architecture

- **GPC**
  - Graphics Processing Cluster
  - Coherent Level 2 Cache
- **SM**
  - Streaming Multiprocessor
  - In CUDA: Multiprocessor, and the fundamental unit for a thread block
- **Core**
  - Scalar ALU for single CUDA thread
  - IEEE 754-2008 compliant for single and dual precision floating point operations



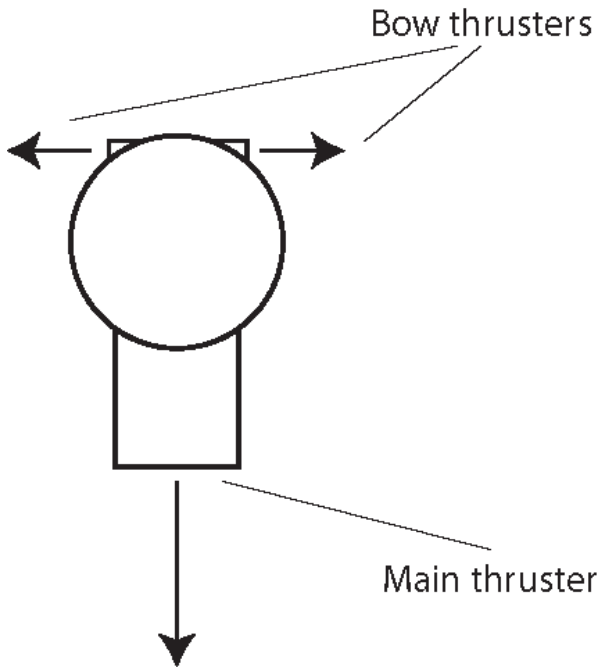
Example Game: The Space Racer

- Simple Space Race Game
- Clients randomly placed in a 3D virtual world.
- Several targets are placed randomly in the 3D virtual world.
- Clients will try to reach the closest target, when a target is reached it will continue to the next.



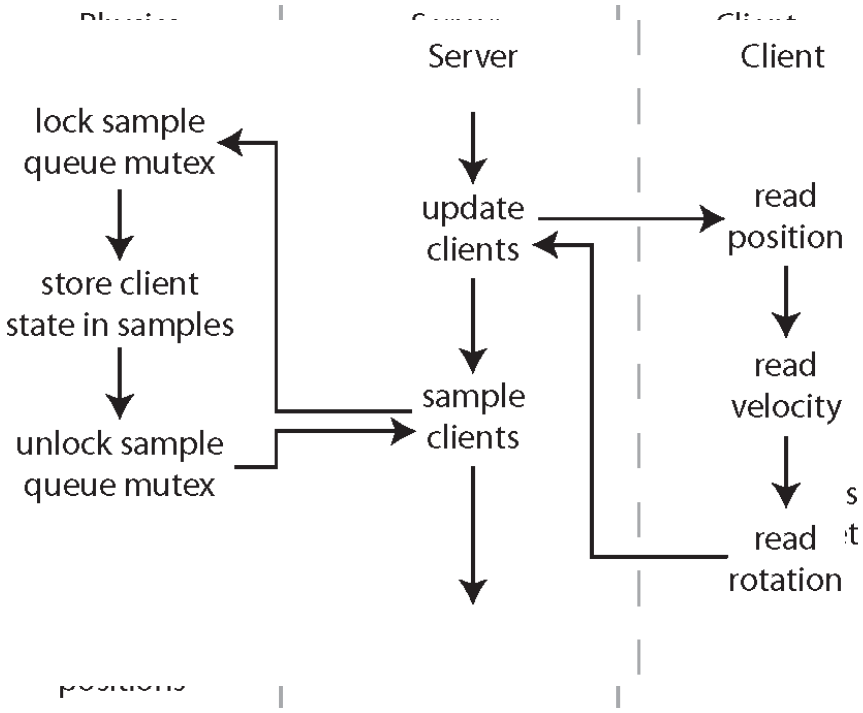
Game Object & Physical Forces in the Game

- Game object have one main thruster for propulsion and two bow thrusters to change course.
- Physical Forces in the game:
  - Linear Motion: Used to implement the vertical gravity, gravity field around the targets, and the main thruster.
  - Angular motion: Used to implement the bow thrusters. This allows the object to rotate in all dimensions



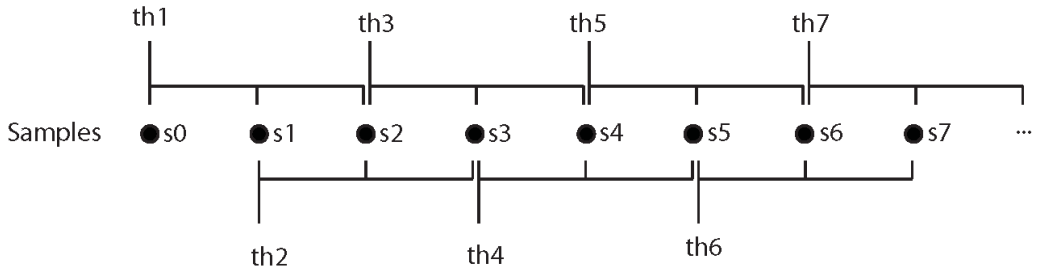
Simulation Structure

- **Generation Mode:**
  - Client will try to reach the closest targets
  - External forces will affect the clients.
  - Write movement data to files, which are used in playback mode.
- **Playback Mode:**
  - Initialize clients and read from files generated in generation mode.
  - Send state data to the server, which will store the samples in queues.



Implementation & Evaluation

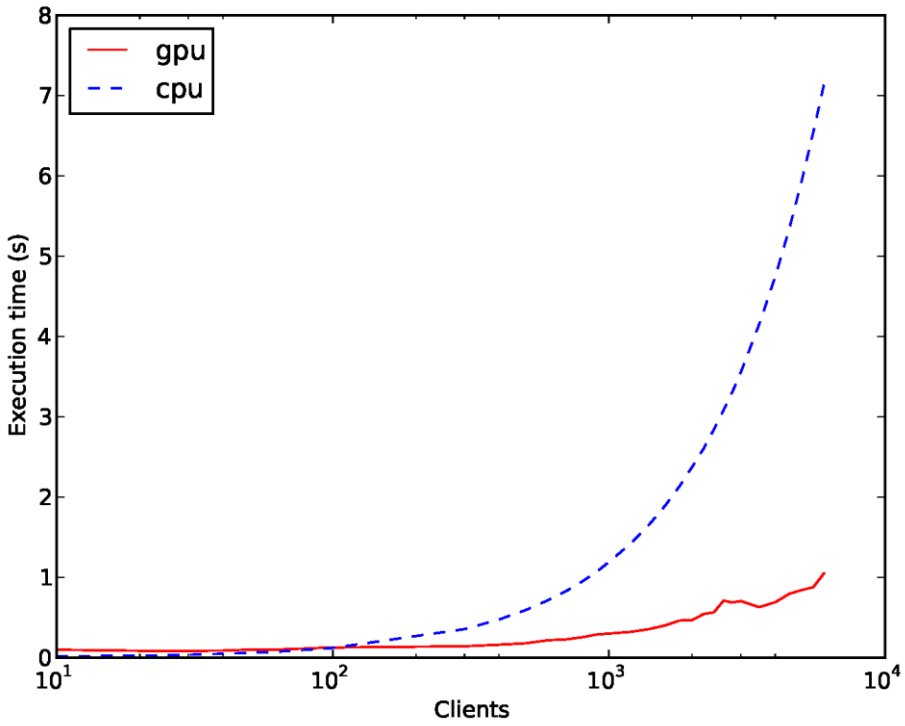
- **Each thread will work on three samples of game state:**
  - A sample contains the movement of a client, and a positional vector
  - The physics engine will be applied in reverse



- **Test Setup:**
  - Intel Core i5 750 2,66 GHz
  - 4 GB RAM
  - Nvidia GeForce GTX 480
  - Nvidia CUDA 3.1

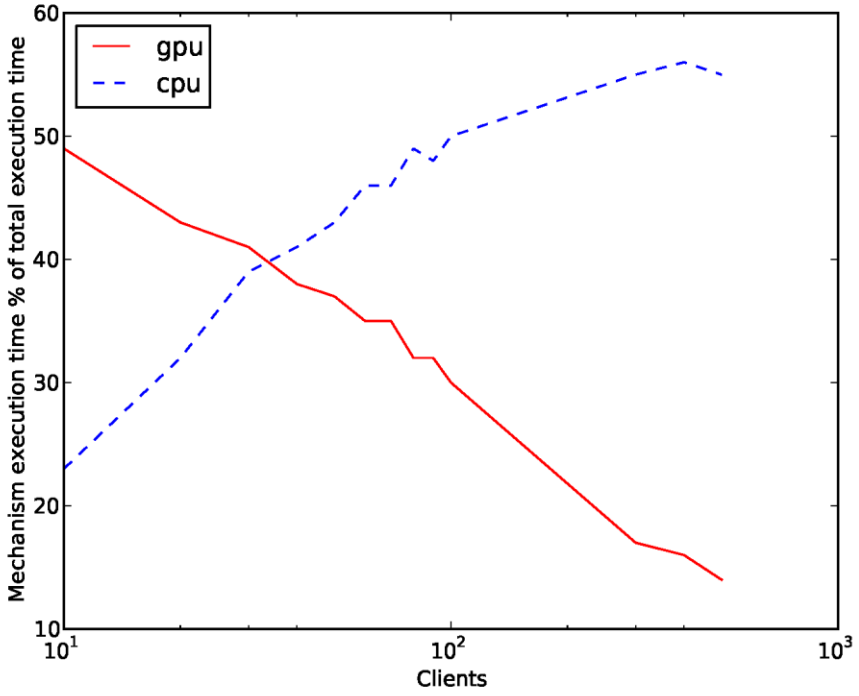
Results: Execution time of the mechanisms

- **Total execution time of the cheat detection system:**
  - Tested 10 to 6000 clients
  - CPU faster with a low number of clients
  - GPU scales good with a higher number of clients.
- Latency for transferring data to the GPU over the PCI Express bus is a challenge for a low numbers of clients.



Results: Percent of time spent on cheat detection

- **Percent of time spent on cheat detection processing:**
  - 10 to 1000 clients
  - With 50 clients, the GPU implementation is spending less time than the CPU version.
- No advanced buffering of samples are currently used. This could improve GPU performance with on a low number of clients



Discussion:

- Cheat detection mechanisms performs differently on GPU and CPU when numbers of clients are increased:
  - Physics operations scale very good on the GPU architecture
  - GPU is more challenging to program compared to a CPU, and the programmer need to think differently.
- Future generations of CPUs from Intel and AMD will integrate a simple GPU on the CPU die, this might reduce the latency of transferring data.
- Further Work:
  - Further optimize the CPU and GPU version of the game.
  - Extend the physical model of the game, and experiment with moving the physics engine to the server.

Conclusion & Further Work

- We have seen that a system processing cheat detection mechanisms on a GPU can outperform the same mechanisms running on a CPU.
- By moving the cheat detection mechanisms to the GPU we are able to offload the CPU allowing the CPU to perform other tasks.

QUESTIONS ?