

CPDS (Parallelism) laboratory assignment:
Solving the heat equation using CUDA

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Index

Index	1
1 Parallelization with CUDA	2
2 Deliverables	3

1

Parallelization with CUDA

In this second laboratory assignment you will parallelize the heat diffusion code with the *Jacobi* solver using CUDA, the programming paradigm developed by NVidia to program GPU devices. Go into the `part4` directory. We suggest that you proceed through the following versions in order to get to the final code:

1. Edit the initial version in `heatCUDA.cu` and `kernels.cu`, identify the parts of the code that do the computation on the CPU and the GPU and understand how both work.
2. Complete the `gpu_Heat` kernel so that each invocation performs the computation of a single element in the matrix. Compile this version using `"make heatCUDA"` and execute it with `"./heatCUDA -t 16"`. Compare the execution time on the CPU version and the GPU version.
3. Do you think the computation of the `residual` is causing the biggest overheads in the GPU version? Comment everything related with the computation of the `residual` and execute again. Do the results demonstrate our hypothesis? Observe that now you execute more iterations in much less time.
4. Implement the computation of the residual on the GPU. Is this improving the execution time with respect to the original GPU code? And with respect to the original CPU version?
5. Finally, modify the kernel so that it makes use of the shared memory within each SM and perform the necessary modifications in the host code accordingly.

2

Deliverables

A single deadline is set to deliver the work done in this laboratory assignment: January 18th, 2013. Deliver a compressed tar file (GZ or ZIP) with the requested C source codes and a PDF explaining how you implemented the reduction operation on the GPU and how do you make use of the shared memory to reduce the latency to memory. The PDF should also contain a table summarizing the execution time of the different versions and the main conclusions of your analysis using Paraver. Only one file has to be submitted per group through the Raco website.