

Summer Semester 2022

## Assignment on Massively Parallel Algorithms - Sheet 3

Due Date June 5, 2022

### Exercise 1 (Histogram, 3 Credits)

In class, you have learned the histogram algorithm (which uses atomic operations).

- a) What is the worst-case input? (in the sense that the GPU algorithm will take the longest time)
- b) What is the best-case input?
- c) In the best-case input, what is the probability that any two threads access the same memory location? Consider 1024 bins and 64 threads and 1 warp (that means all 64 threads operate in lockstep). It could help to think of the reverse problem of no collision.

### Exercise 2 (CUDA: Matrix Vector Multiplication, 5 Credits)

Start from the framework `matrixVectorMul`. There, matrix A is stored in row major order.

- a) Implement a matrix vector multiplication kernel for the above matrix stored in row major order. (2 Credits)
- b) Implement the conversion of the above matrix in column major order before copying its elements to the GPU (create a new variable instead of modifying `h_A` for the tests to work) and the modify the above matrix vector multiplication kernel to handle matrices stored in column major order. (2 Credits)
- c) Compare run times between the above two implementations (row- vs column major order) for different matrix sizes and provide the arguments for the differences/similarities between run times for these two implementations. (1 Credit)