Parallel Computing with GPUs

Sorting and Libraries
Part 3 – Applications of Sorting

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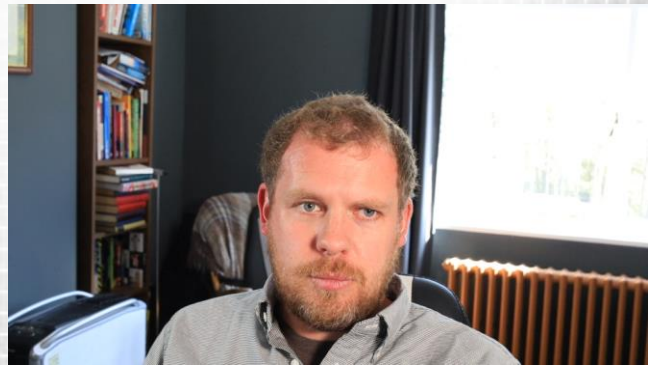
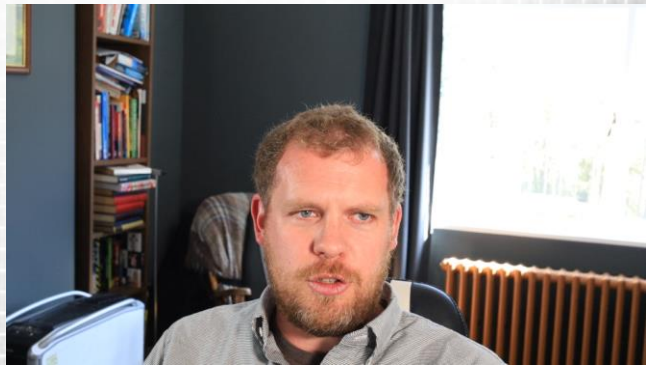


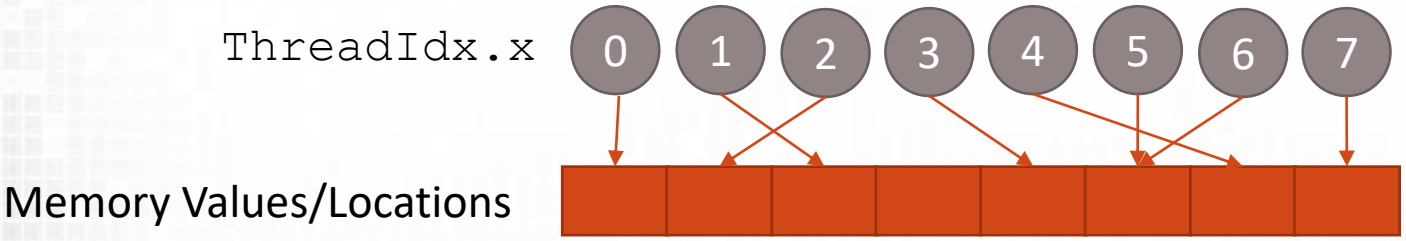
This Lecture (learning objectives)

- Applications of Sorting (binning)
  - Present the concept of spatial binning
  - Demonstrate the use of spatial binning for particle interactions



Sorting and parallel primitives

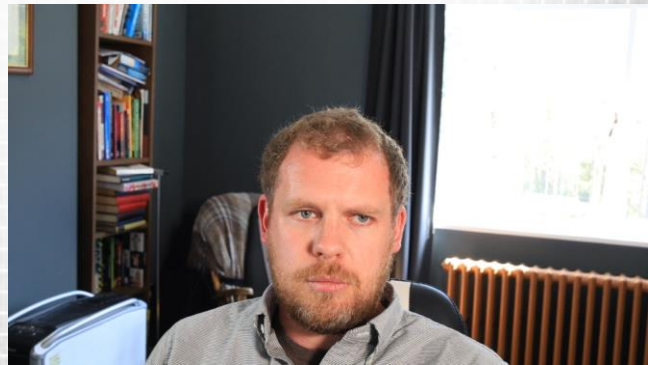
- Can be very useful for building data structures
  - We can use prefix sum for writing multiple values per element
- Remember Gather vs Scatter
  - What if our outputs are scattered to output
  - Very common in particle simulations etc.
    - Outputs might represent spatial bins



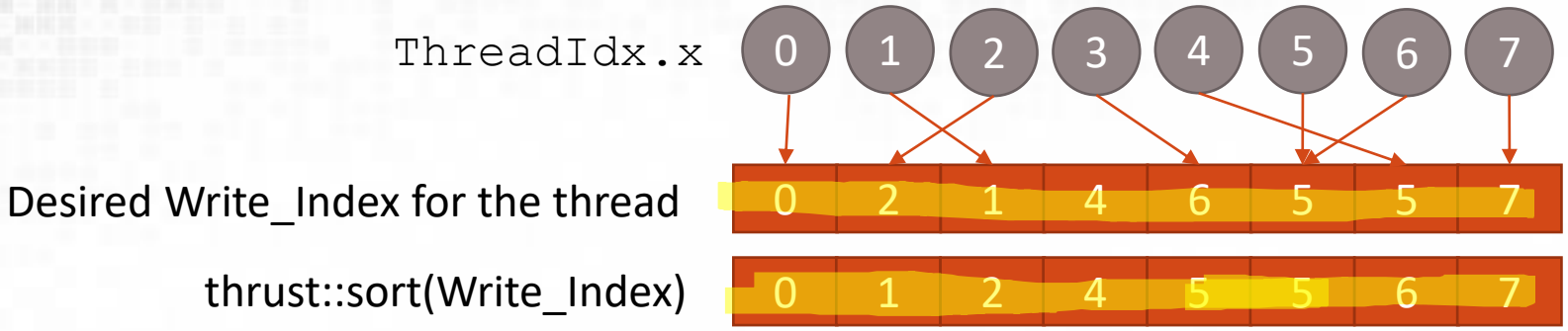
Scatter operation

- Write to a number of locations
- Random access write?

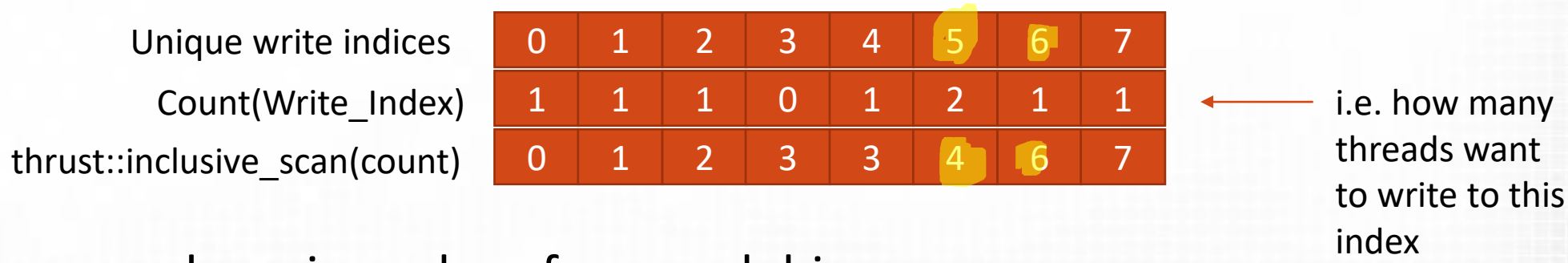
- How to read multiple values afterwards?



Binning and Sorting



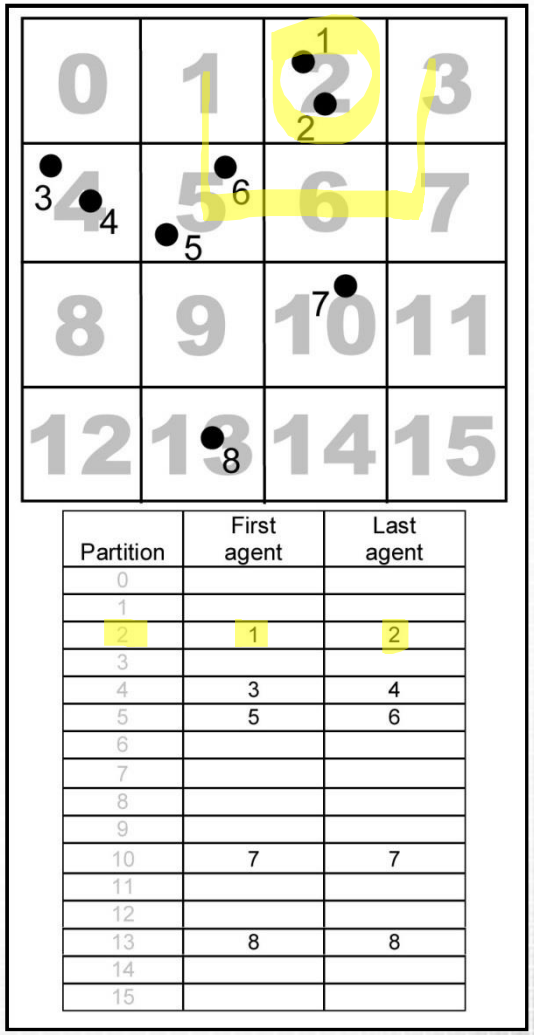
Build a data structure



- We can now read varying values from each bin
  - E.g. for location 5
    - inclusive_scan gives starting index of 4
    - Iterate from index 4 for a count of 2 to find all values of write_index 5

Particle interaction example

- As with previous slide use sorting
  - Divide the environment according to some interaction radius
  - Output particle key value pairs (keys are location determined through some hash function)
  - Sort Keys
  - Reorder particles based on key pairs
  - Generate a partition boundary table
    - Histogram count and prefix sum
  - Each particle needs to read all particles in its own location and any neighbouring location
    - Guarantees particle interactions within the interaction radius



Partition	First agent	Last agent
0		
1		
2	1	2
3		
4	3	4
5	5	6
6		
7		
8		
9		
10	7	7
11		
12		
13	8	8
14		
15		

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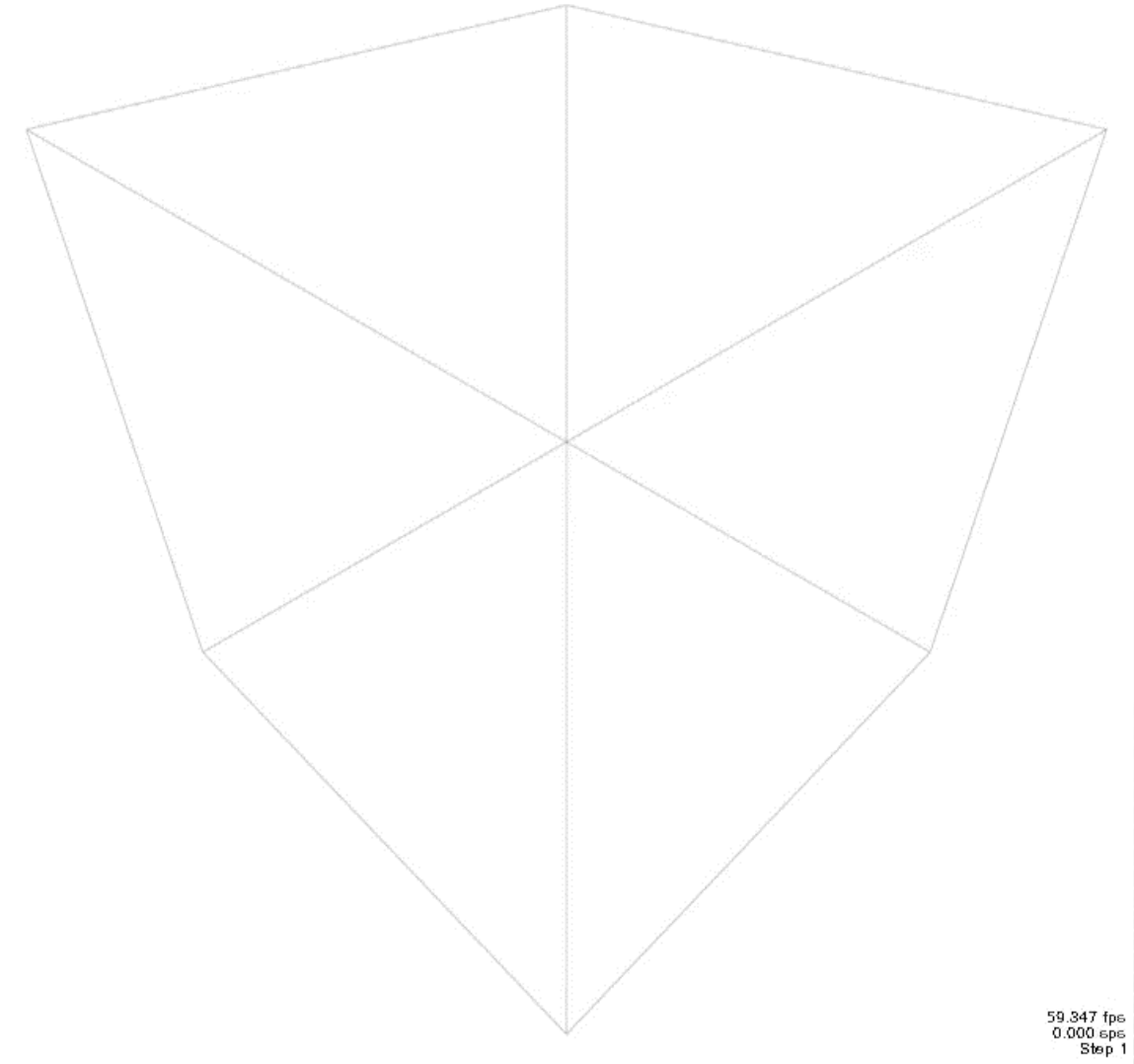
Example: FLAME GPU



Summary

- Applications of Sorting (binning)
  - Present the concept of spatial binning
  - Demonstrate the use of spatial binning for particle interactions