

Chasing Away **RAts**: Semantics and Evaluation for **Relaxed Atomics** on Heterogeneous Systems

Matthew D. Sinclair, Johnathan Alsop, Sarita V. Adve
University of Illinois @ Urbana-Champaign
hetero@cs.illinois.edu

“Everyone can cook”



“Everyone (thinks they) can cook”



“Everyone (thinks they) can cook”



Health code violations

Typhus



Meningitis



Plague



Salmonellosis



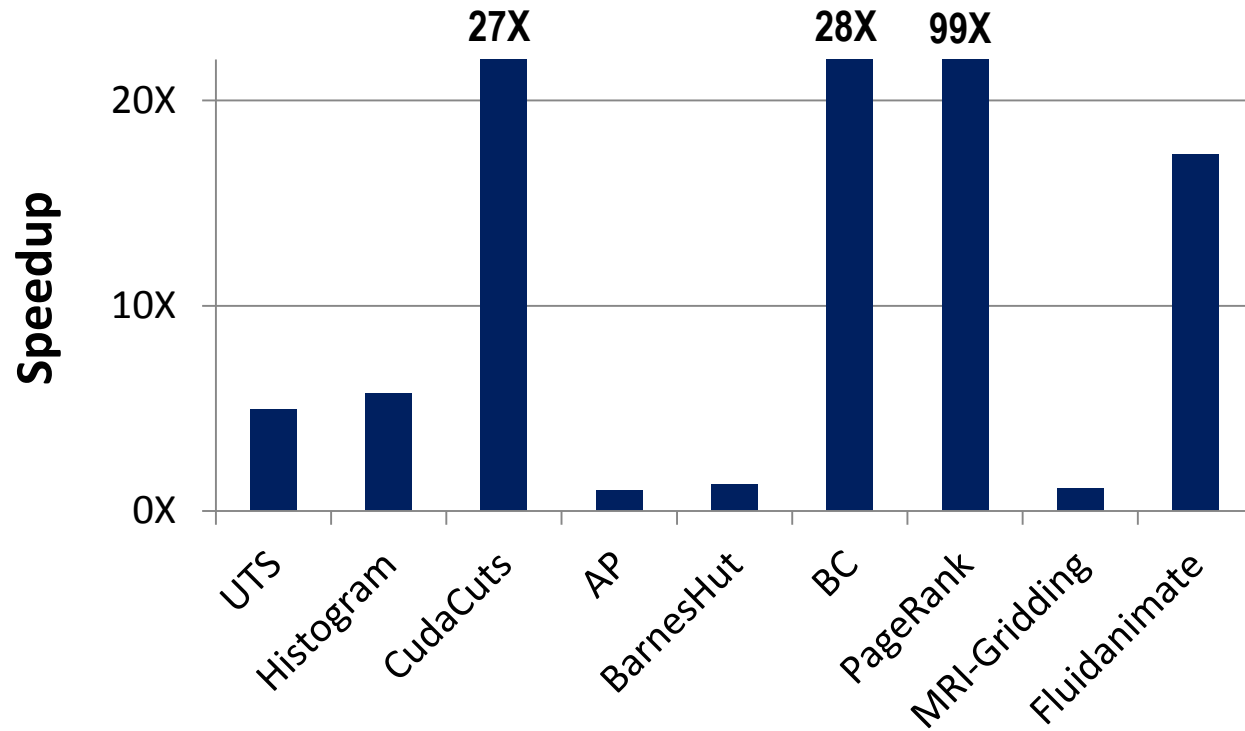
Rat-bite Fever



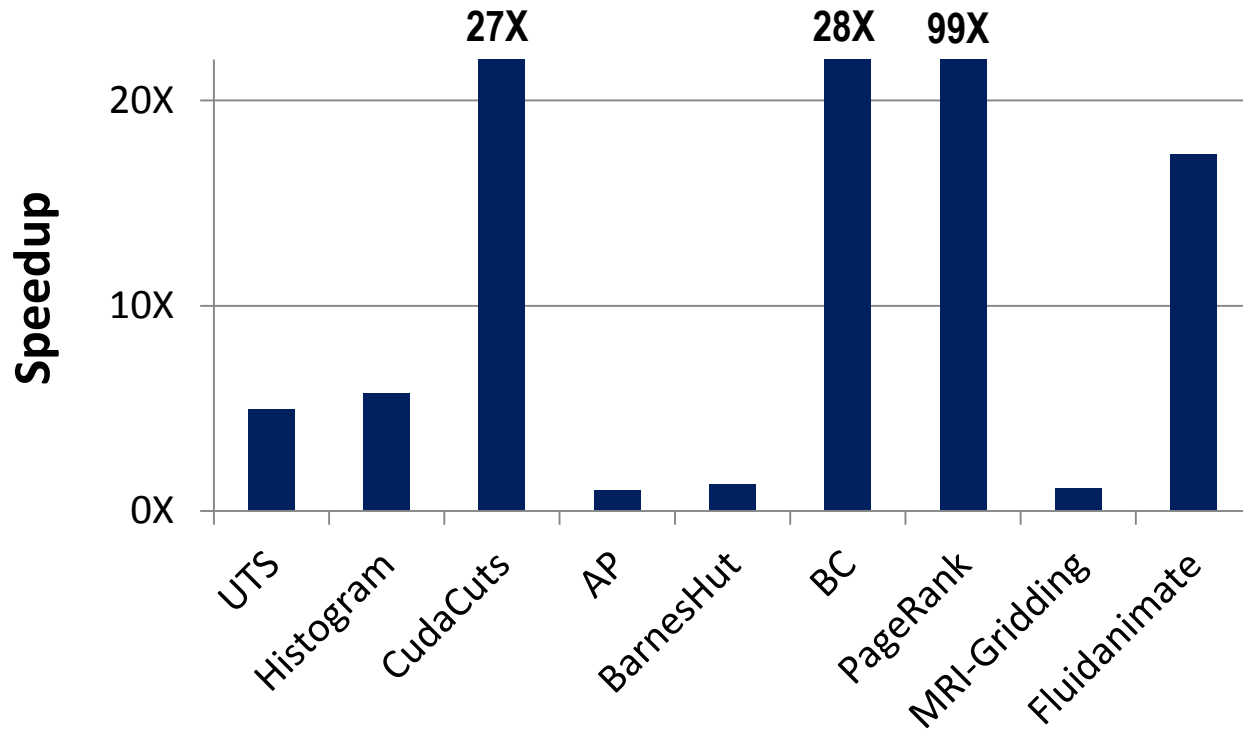
“Everyone (thinks they) can ~~cook~~” use relaxed atomics (RATs)



“Everyone (thinks they) can ~~cook~~” use relaxed atomics (RATs)



“Everyone (thinks they) can ~~cook~~” use relaxed atomics (RATs)

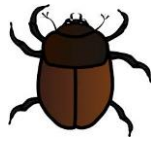


Correctness ~~Health code~~ violations

Incorrect usage  **No formal specification**  Not portable



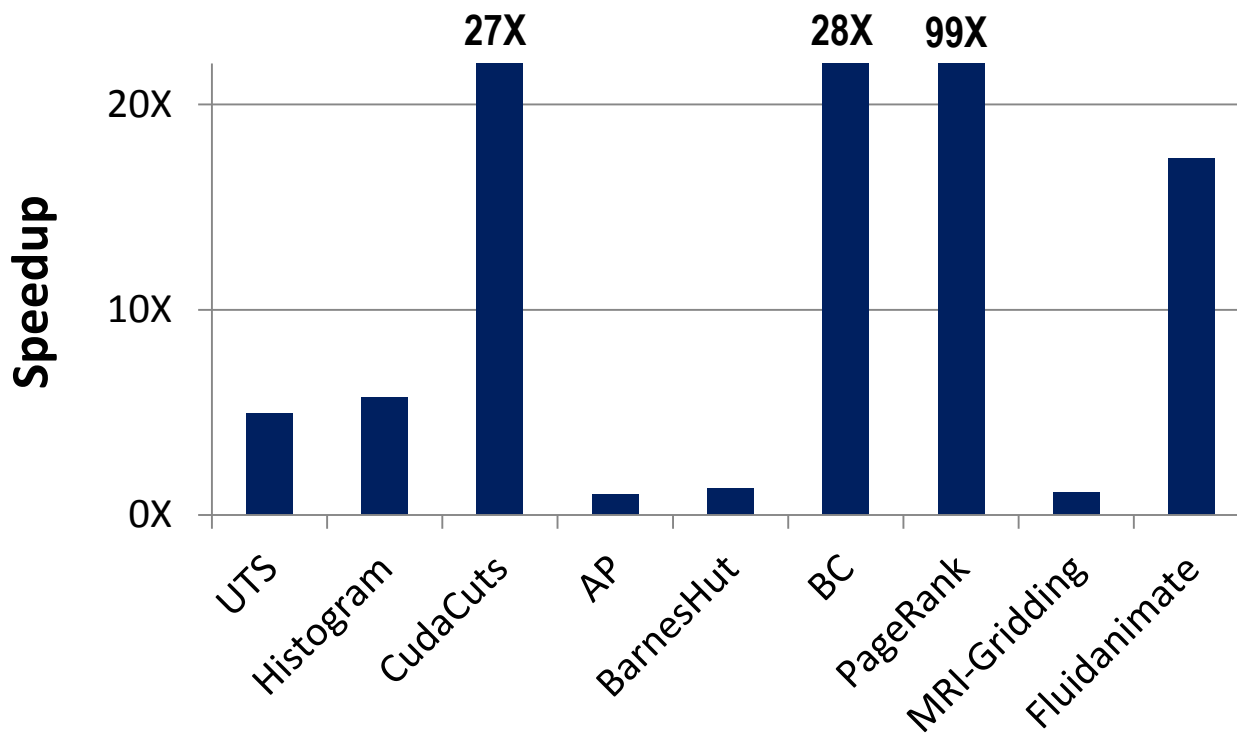
Hard to debug



Out-of-thin-air values



“Everyone (thinks they) can ~~cook~~” use relaxed atomics (RATs)



Correctness ~~Health code~~ violations

Incorrect usage  **No formal specification**  Not portable



Hard to debug



Out-of-thin-air values



Our Goal: Formal Specification + Efficiency

Data-Race-Free-Relaxed (DRFrlx) Consistency

Analyze how real codes use relaxed atomics

Work Queues Seqlocks

Event Counters Ref Counters

Flags Split Counters



Data-Race-Free-Relaxed (DRFrlx) Consistency

Analyze how real codes use relaxed atomics

Work Queues Seqlocks

Event Counters Ref Counters

Flags Split Counters

Previous Work: Explain RAts behavior



Data-Race-Free-Relaxed (DRFrlx) Consistency

Analyze how real codes use relaxed atomics

Work Queues Seqlocks

Event Counters Ref Counters

Flags Split Counters

Previous Work: Explain RATs behavior

Our Work: Constrains RATs use



Data-Race-Free-Relaxed (DRFrIx) Consistency

Analyze how real codes use relaxed atomics

Work Queues

Seqlocks

Event Counters

Ref Counters

Flags

Split Counters

Previous Work: Explain RATs behavior

Our Work: Constrains RATs use



DRFrIx: SC-centric semantics + efficiency

Data-Race-Free-Relaxed (DRFrIx) Consistency

Analyze how real codes use relaxed atomics

Work Queues

Seqlocks

Event Counters

Ref Counters

Flags

Split Counters

Previous Work: Explain RATs behavior

Our Work: Constrains RATs use



DRFrIx: SC-centric semantics + efficiency

Everyone can use RATs safely