Static Slicing of Concurrent Programs

- An Evaluation -

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Initial situation

Precise slicing of concurrent programs with procedures and recursion

- J. Krinke: Context-Sensitive Slicing of Concurrent Programs (ESEC/FSE, September 2003)
- M. Nanda and S. Ramesh: Interprocedural slicing of multithreaded programs with applications to Java (ACM TOPLAS, 2006)

Extending SDGs for concurrent programs

Interference dependence

- Statement **n** ist interference dependent on statement **m**, if:
  1. **n** uses variable v and **m** defines v
  2. **m** and **n** are executed concurrently
- No execution order between **n** and **m**

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Example – slice for node 7

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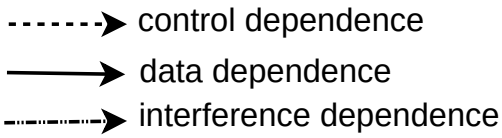

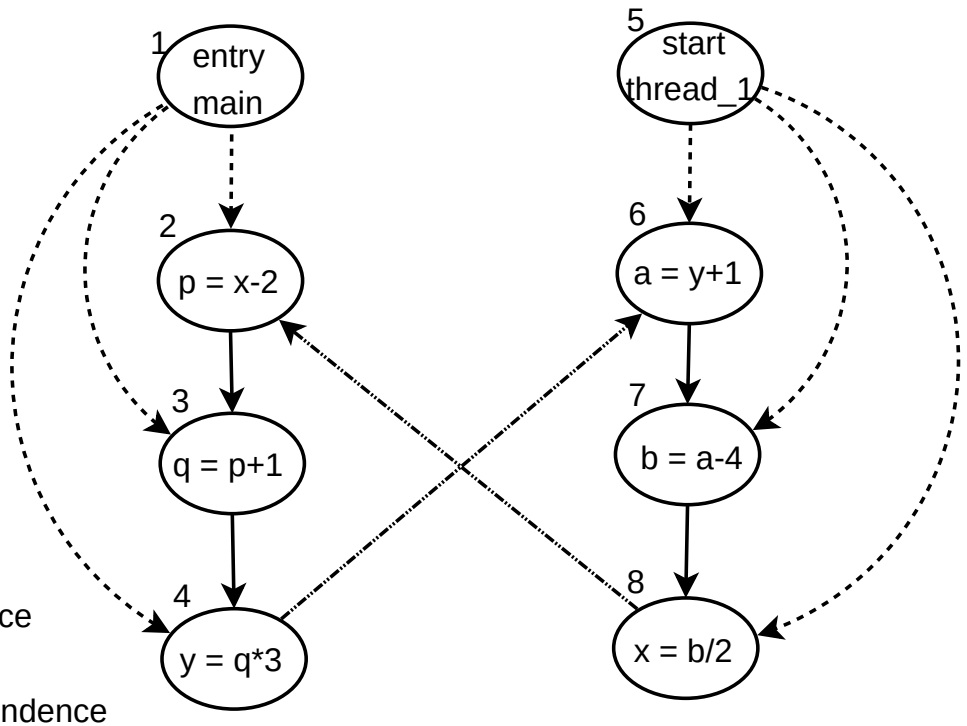

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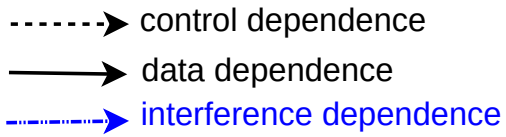

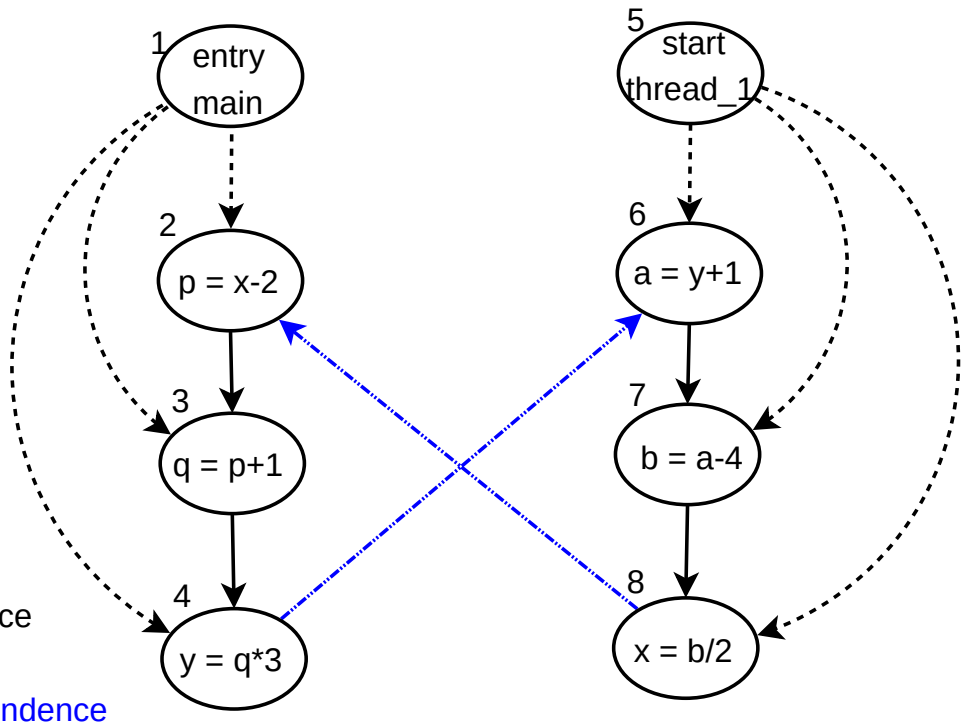

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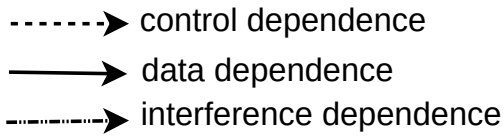

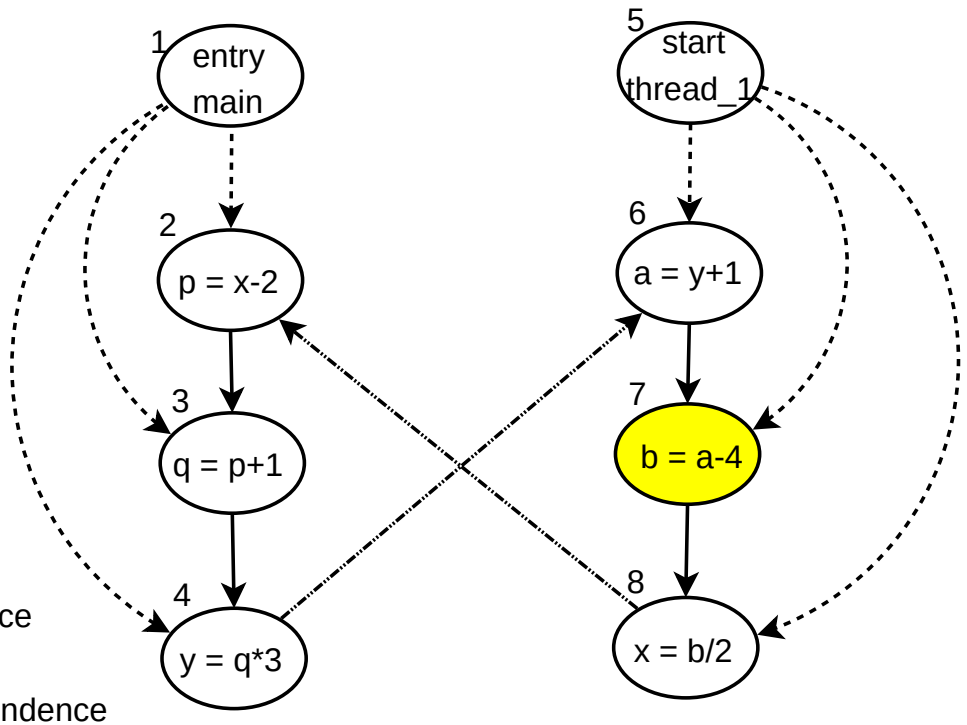

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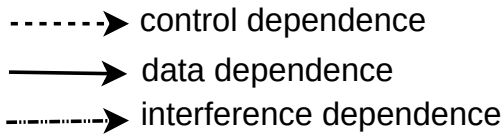

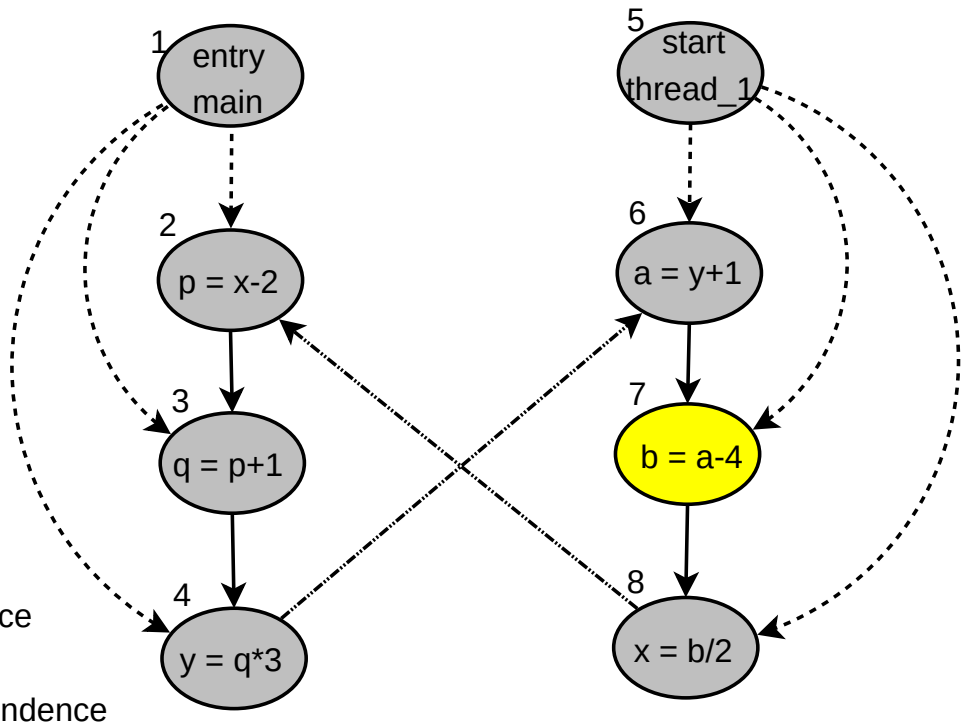

Example – imprecise result

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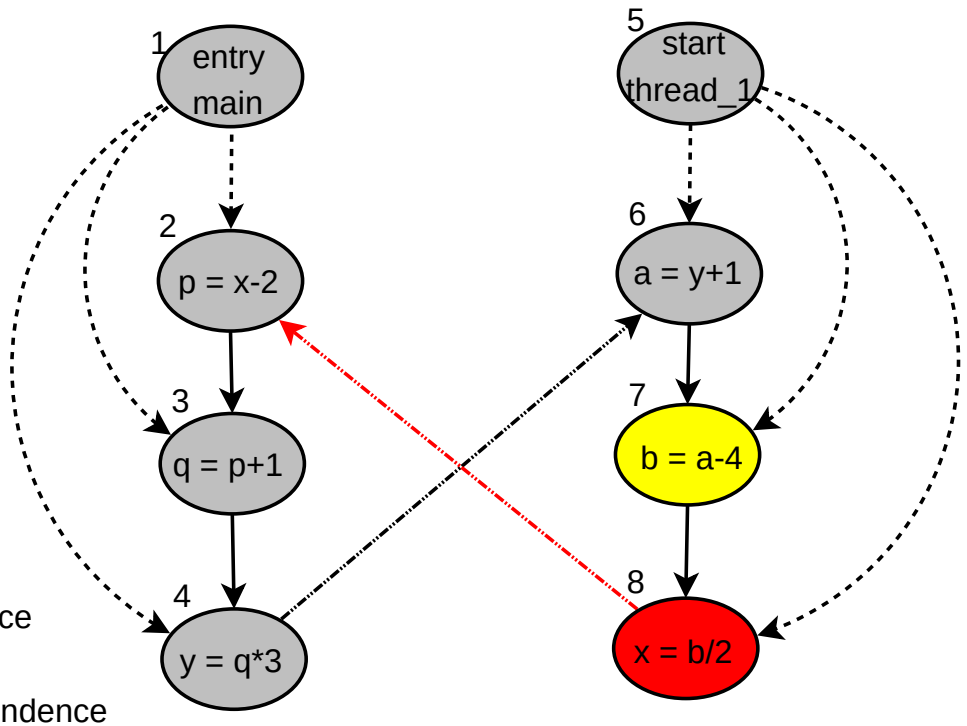

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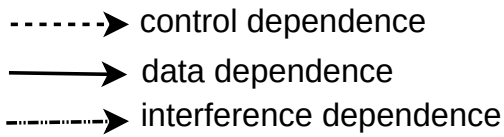

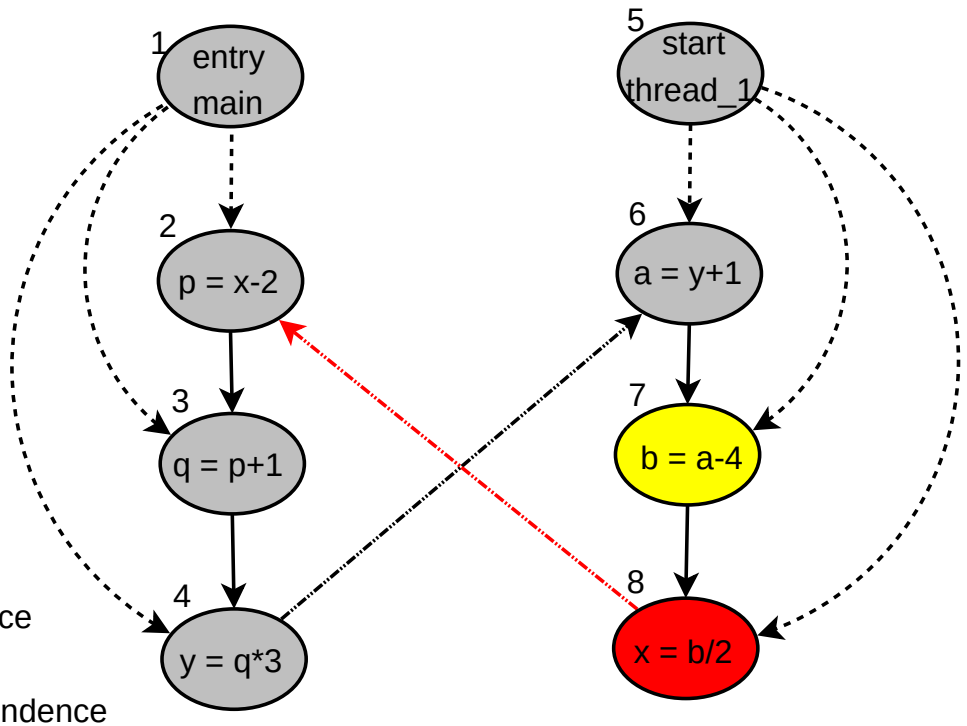

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- Nodes can be visited multiple times
  - Remember where each thread was left to reach a node
  - → Nodes are annotated with *thread states*
  - Visited as often as its thread state annotations differ
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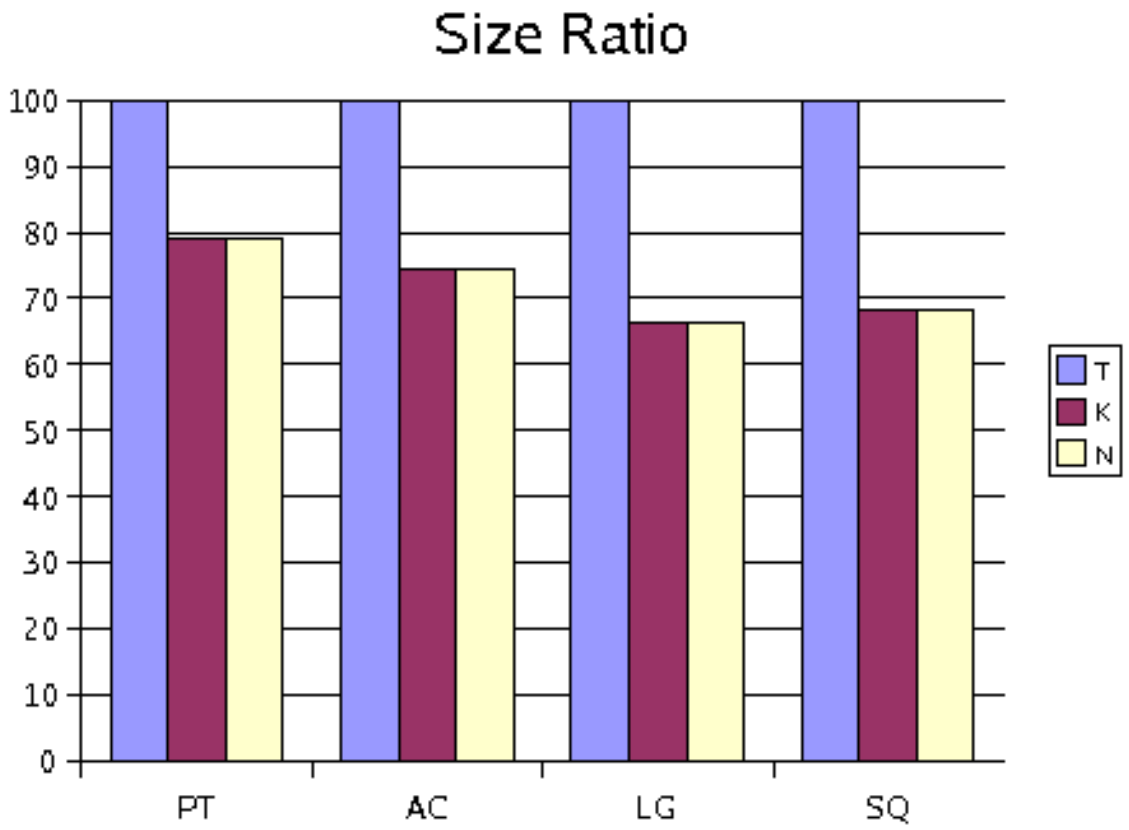
Sample case study

- Algorithms
  - T – transitive approximation
  - K – optimized version of Krinke's algorithm
  - N – optimized version of Nanda's algorithm

- 4 sample programs

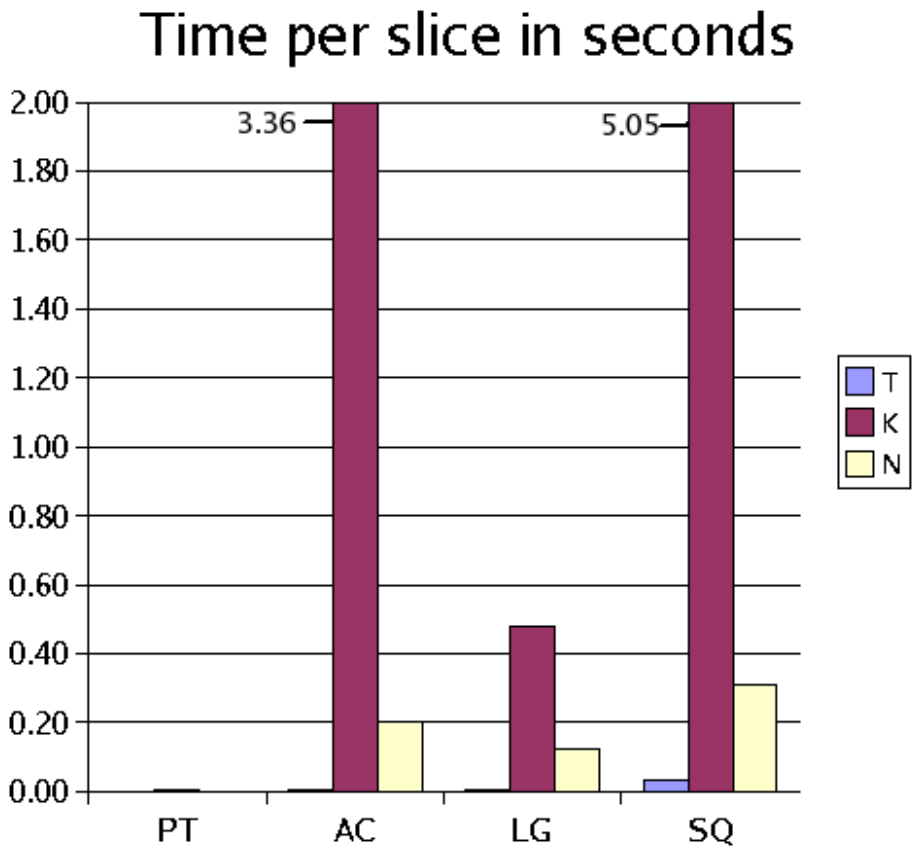
Name	Nodes	Edges	Classes	Methods	Threads
PrecisionTest	328	904	6	10	2
AlarmClock	4085	13842	17	74	2
LaplaceGrid	10022	100730	22	95	3
SharedQueue	17998	139480	23	122	3

Average size



- Gain of precision: up to 35%

Average speed



- K and N are much more expensive than T

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- Now we double the number of threads in these programs
- What will happen?

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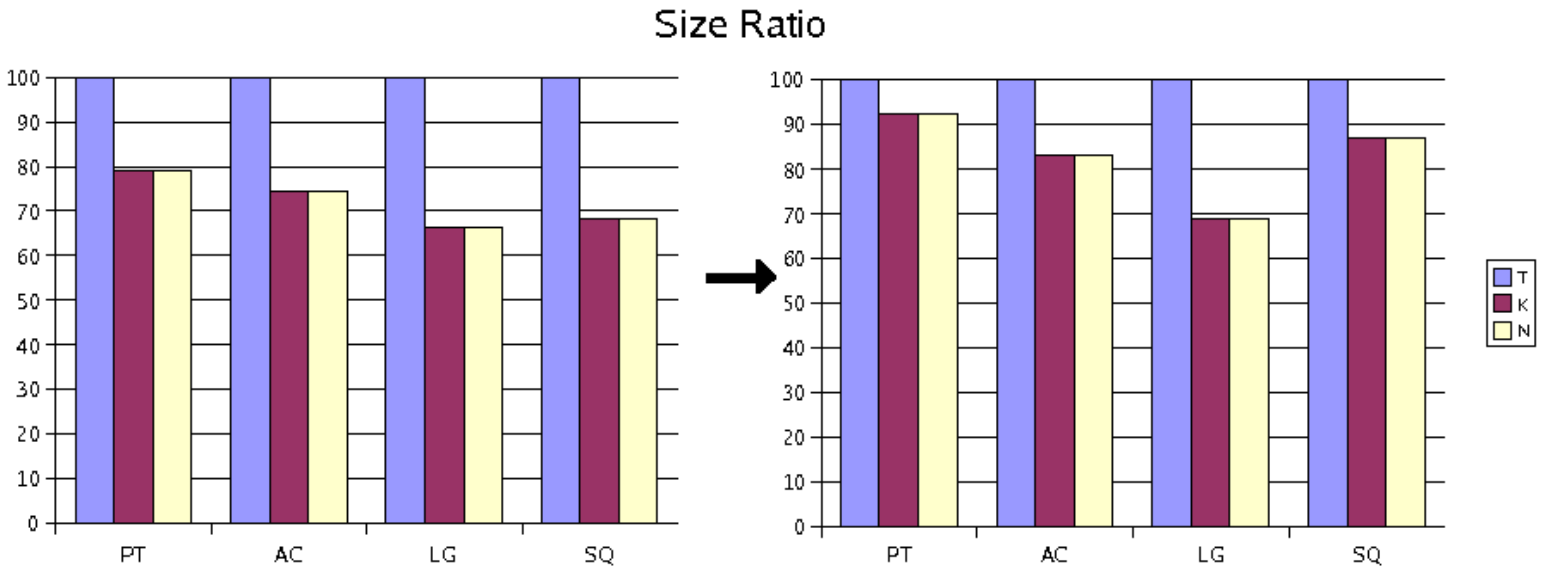
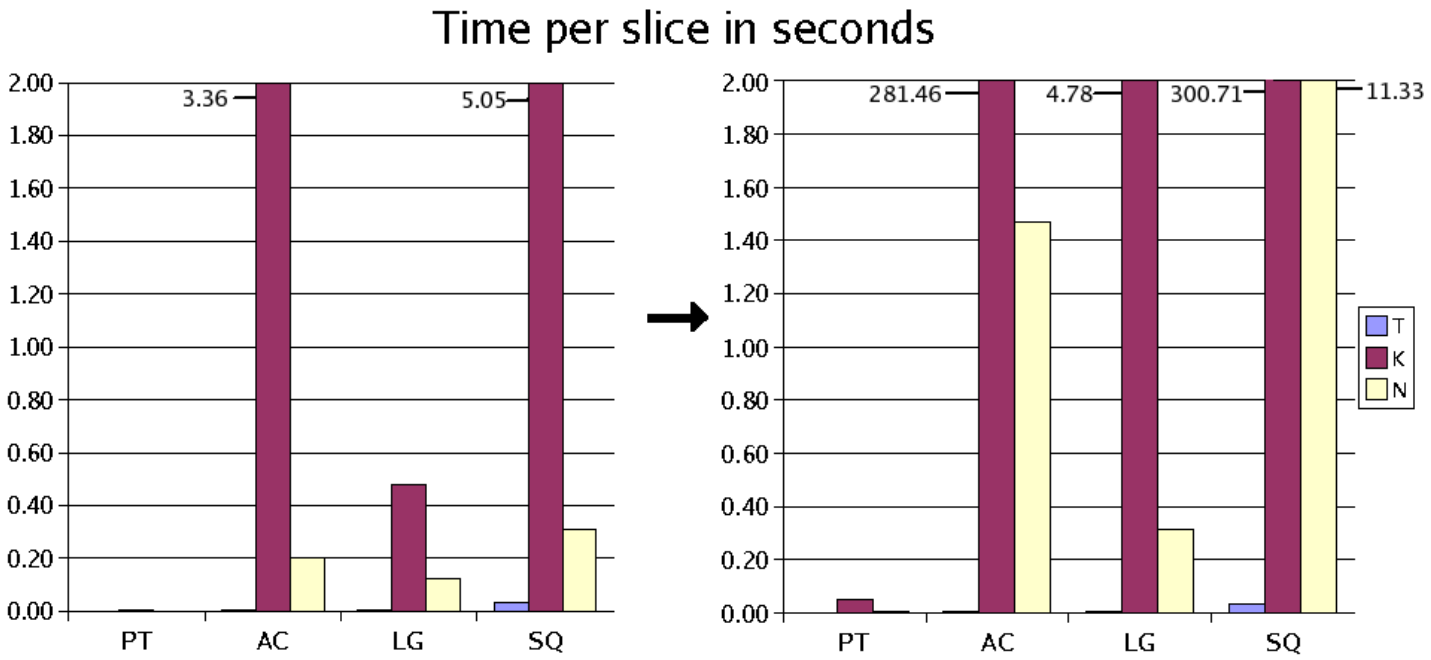


- The gain of precision decreases...

Average speed



- ...and the costs explode

Conclusion

⇒ **Precise slicing of concurrent programs does not scale for real-world programs**

⇒ **We need a trade-off between precision and speed**

- K-limitation for time travel detection

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Questions?