Managing Long-Running Queries

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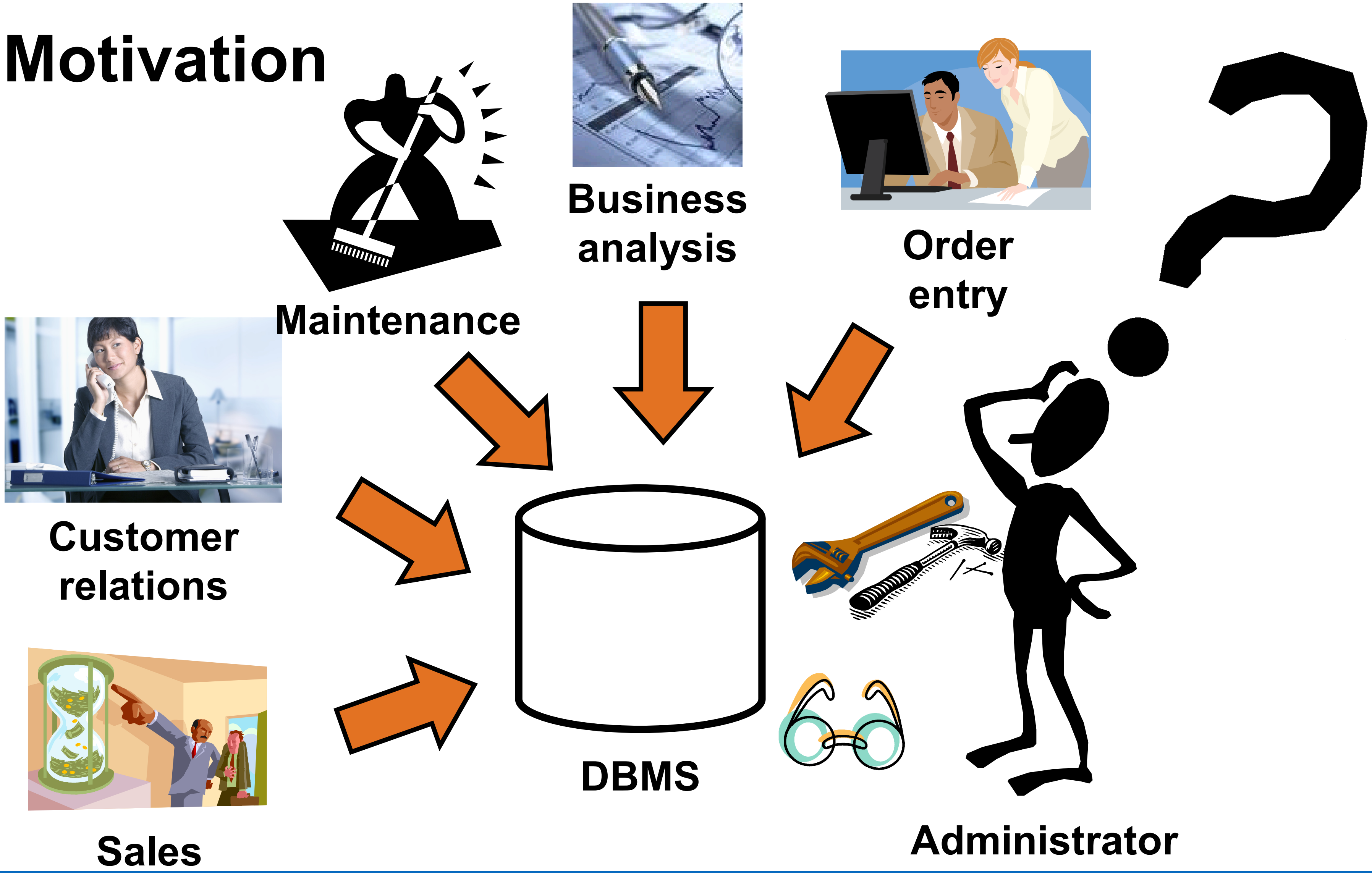
Palo Alto, CA, USA

Motivation


Maintenance
Business analysis
Order entry
Customer relations
Sales
DBMS
Administrator

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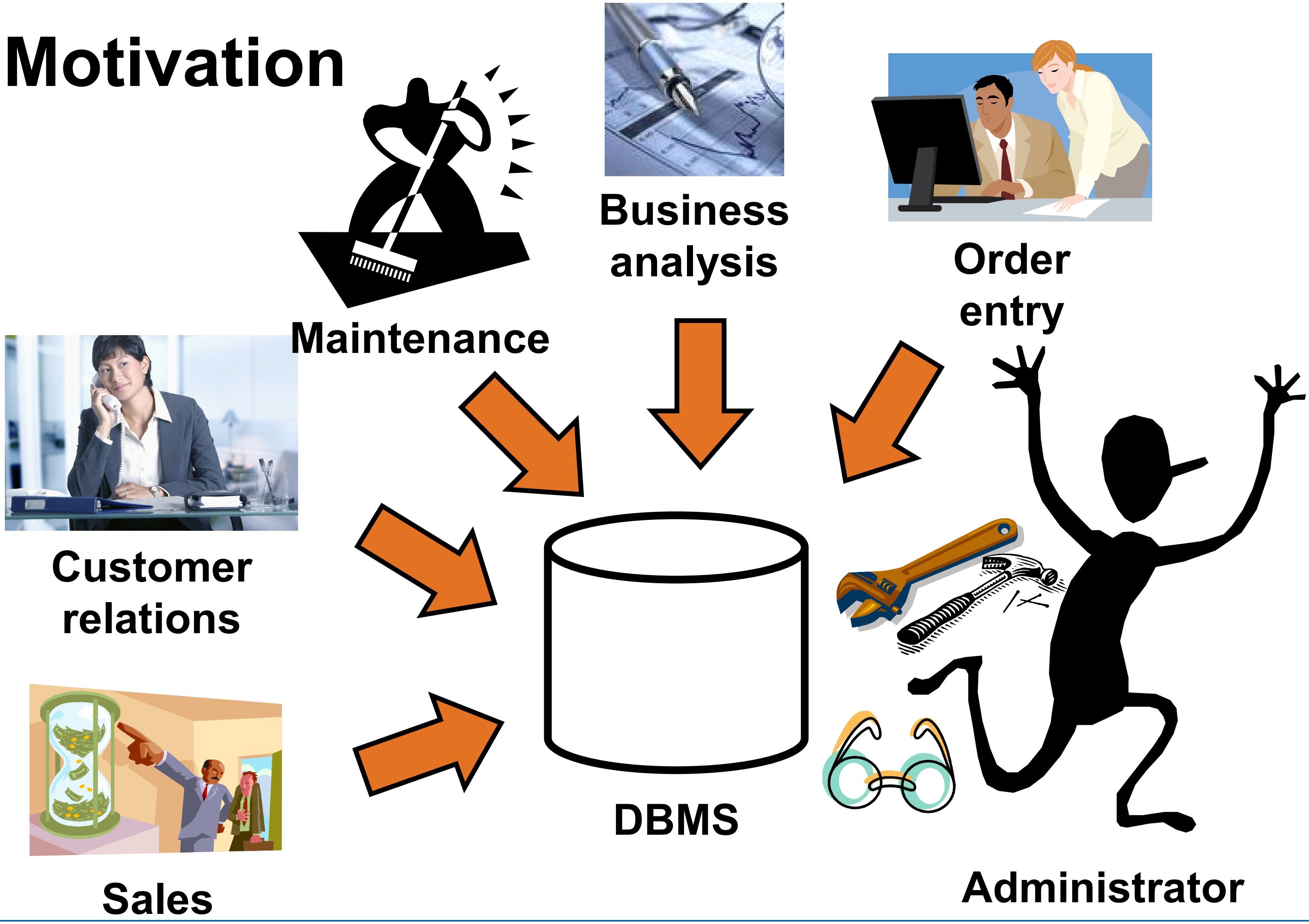

Maintenance

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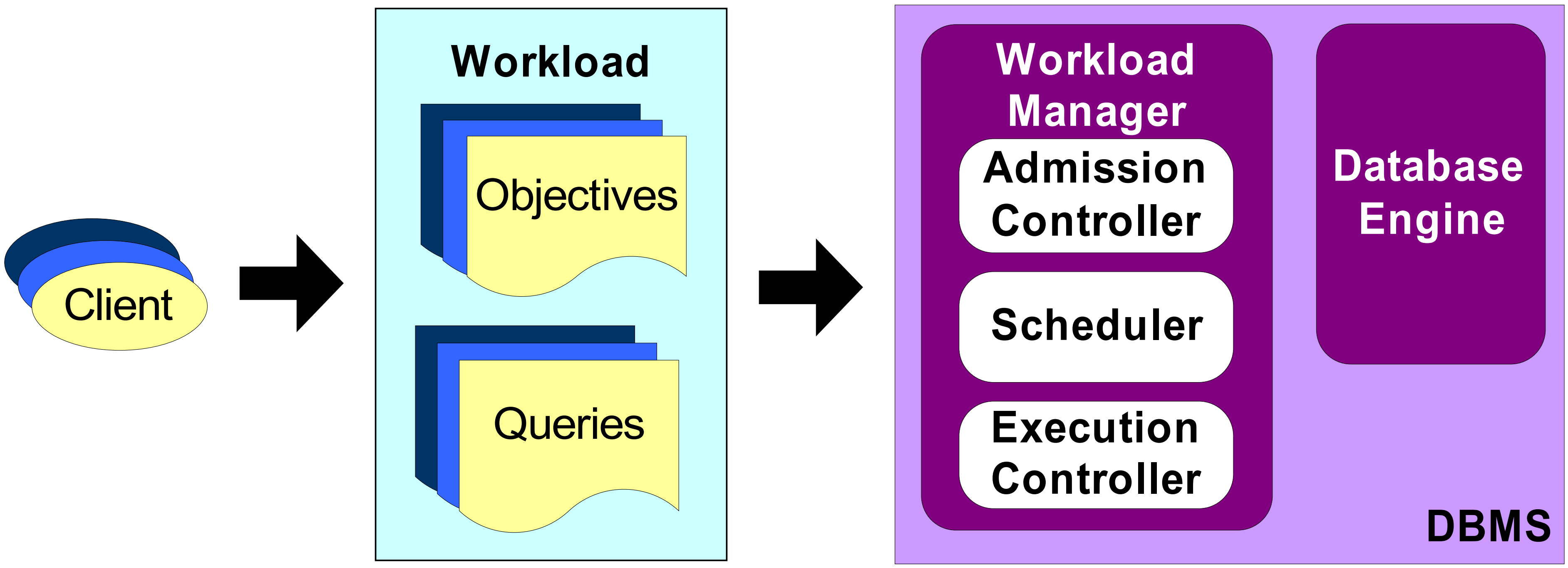
Goals of this work

- Develop technology to study policies for mixed workloads
- Initial study of managing mixed workloads, in particular: impact of long-running queries on a workload
  - Unreliable cost estimates
    under-informed admission control and scheduling decisions
  - Unobserved resource contention
    monitored resource not the source of contention
  - System overload

Outline

- Workload management components & workload management policies
- Experiments
- Conclusions

Workload management overview



Experimental approach

- Create workloads that inject “problem” queries (our workloads are derived from actual mixed workload queries)
- Develop a workload management software that implements admission control, scheduling, and execution control policies
- Workload manager feeds queries into database engine **simulator**
  - Investigate workloads that run for hours
  - Obtain reproducible results
  - Experiment with comprehensive set of workload management policies
  - Inject problem queries

Experimental input: queries

query type	size of query pool	queries per workload	average elapsed time
short	2807	400	30 sec
medium	247	23	10 min
long	48	3	1 hr

Problem queries

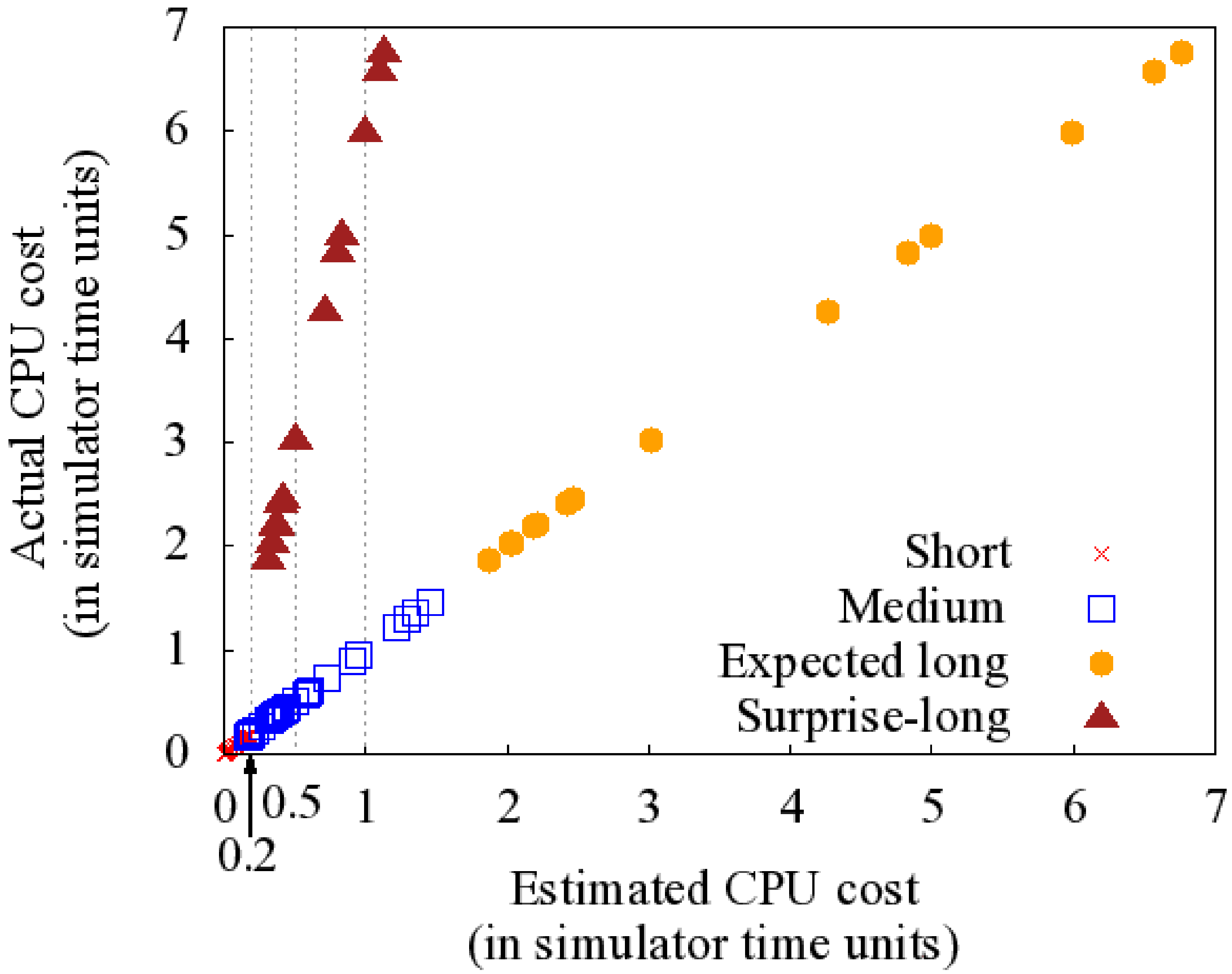
Taxonomy of long-running queries

Query type	Query expected to be long	Query progress reasonable	Uses equal share of resources
expected-long	yes	yes	yes
expected-hog	yes	yes	no (> equal)
surprise-long	no	yes	yes
surprise-hog	no	yes	no (> equal)
overload	no	no	yes
starving	no	no	no (< equal)

Experimental inputs

- **Workload types:** expected-long, surprise-long, ~~surprise-hog~~
- **Admission control**
  - Policies: none, limit expected costs of a query
  - Thresholds: 0.2m, 0.5m, and 1.0m
- **Scheduling**
  - Queue: FIFO
  - Multiprogramming level (MPL)
- **Execution control**
  - Policies: none, kill, kill&requeue, suspend&resume
  - Thresholds: absolute 5000 (time units), absolute 12000, absolute 5000 & progress < 30%, relative 1.2x

How did we choose the thresholds?



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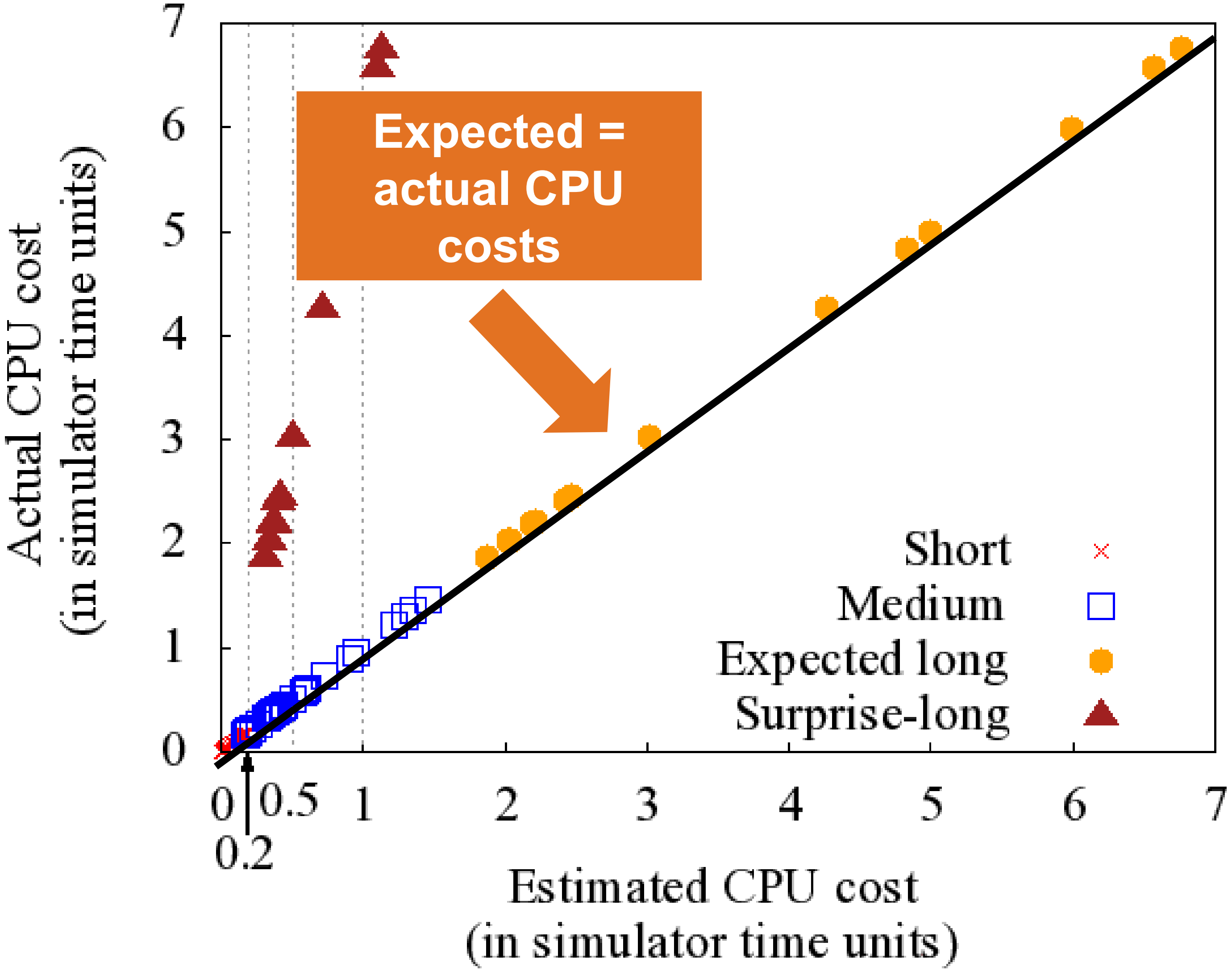
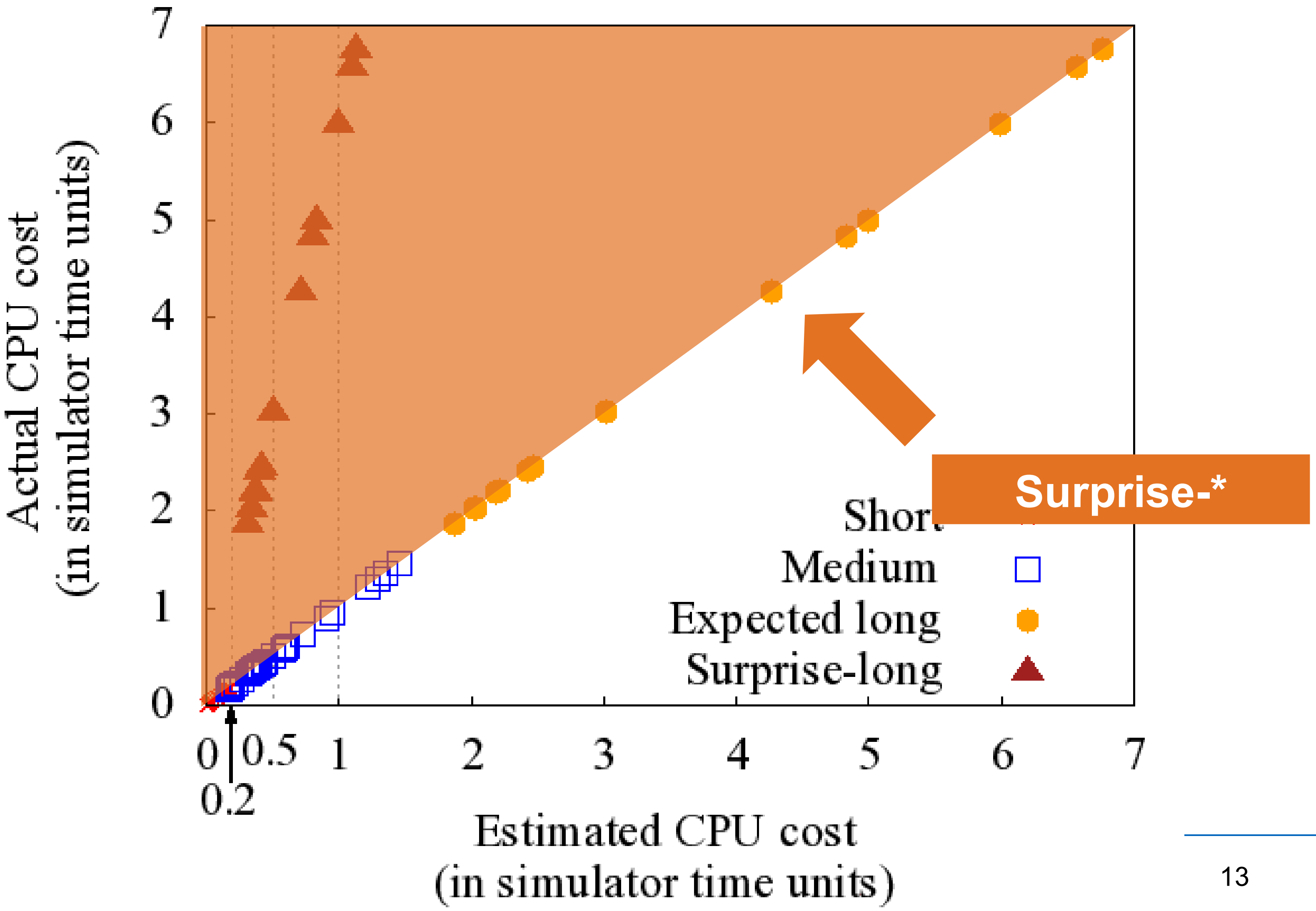


Expected = actual CPU costs

How did we choose the thresholds?



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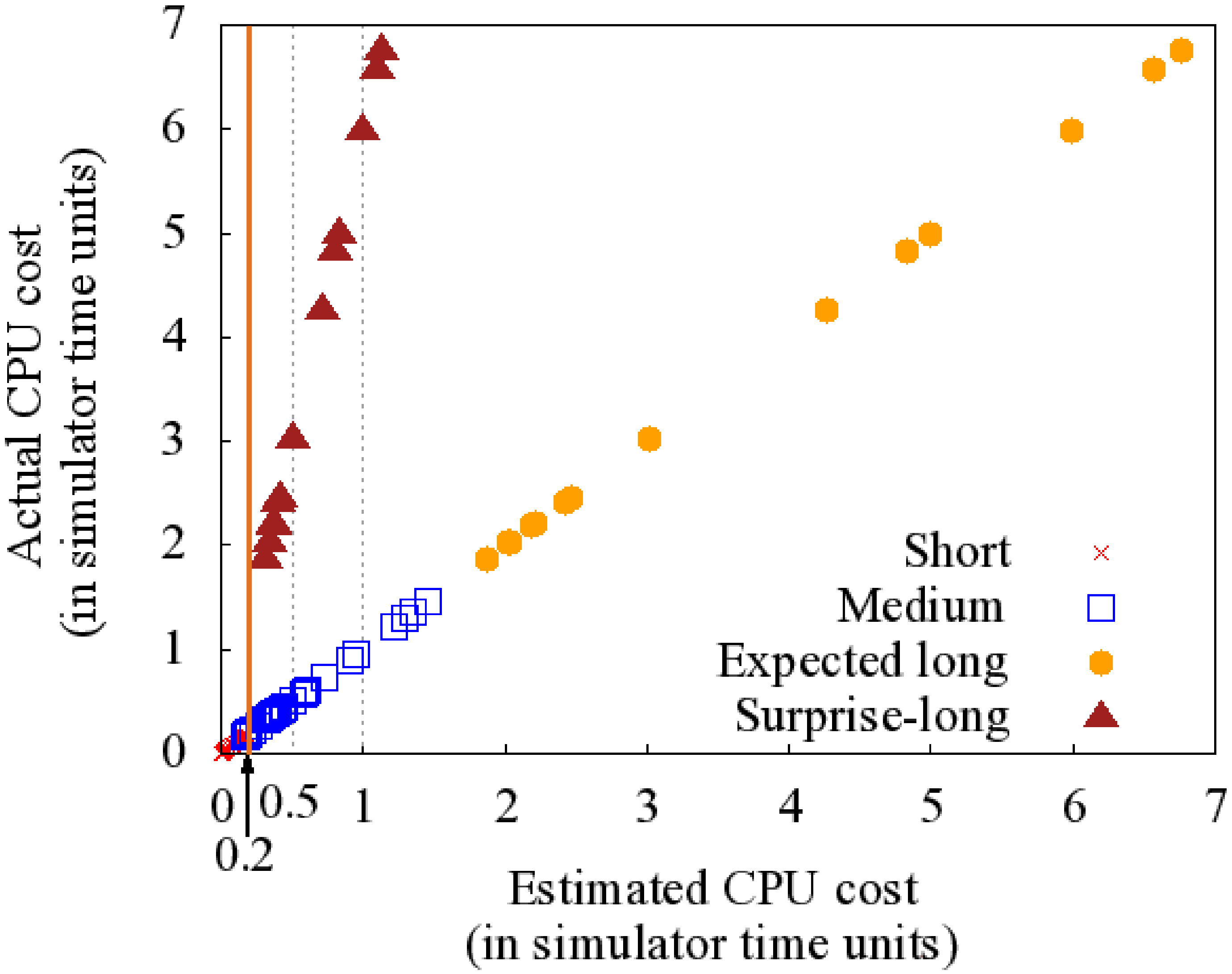

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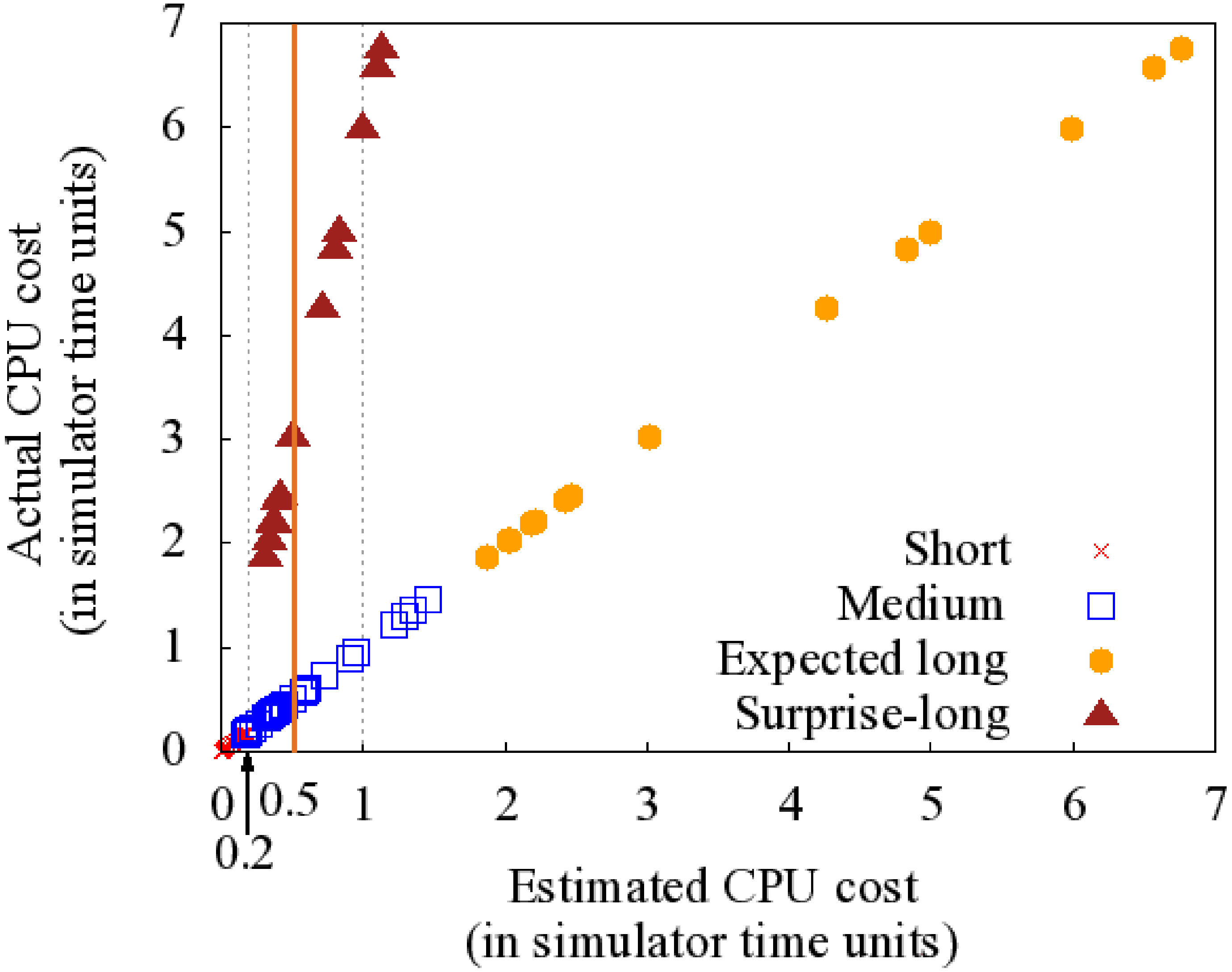

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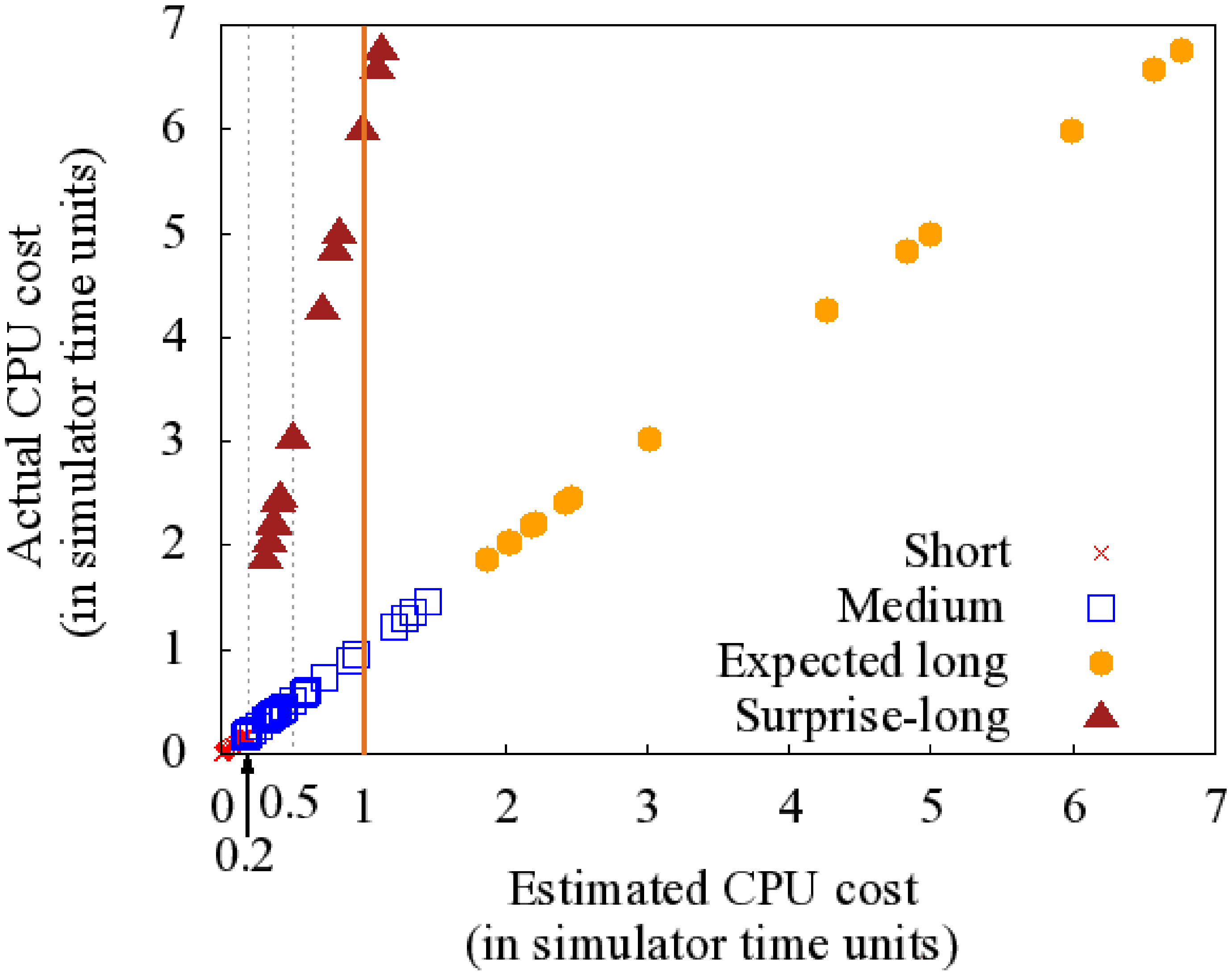
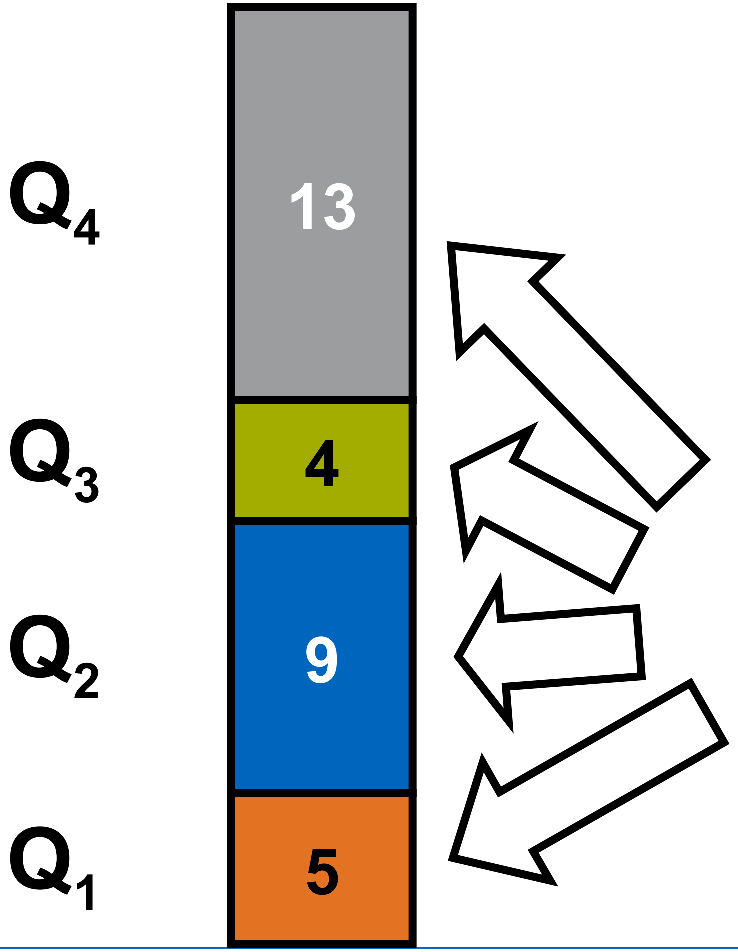


Experimental measure - weighted makespan



Elapsed time of queries

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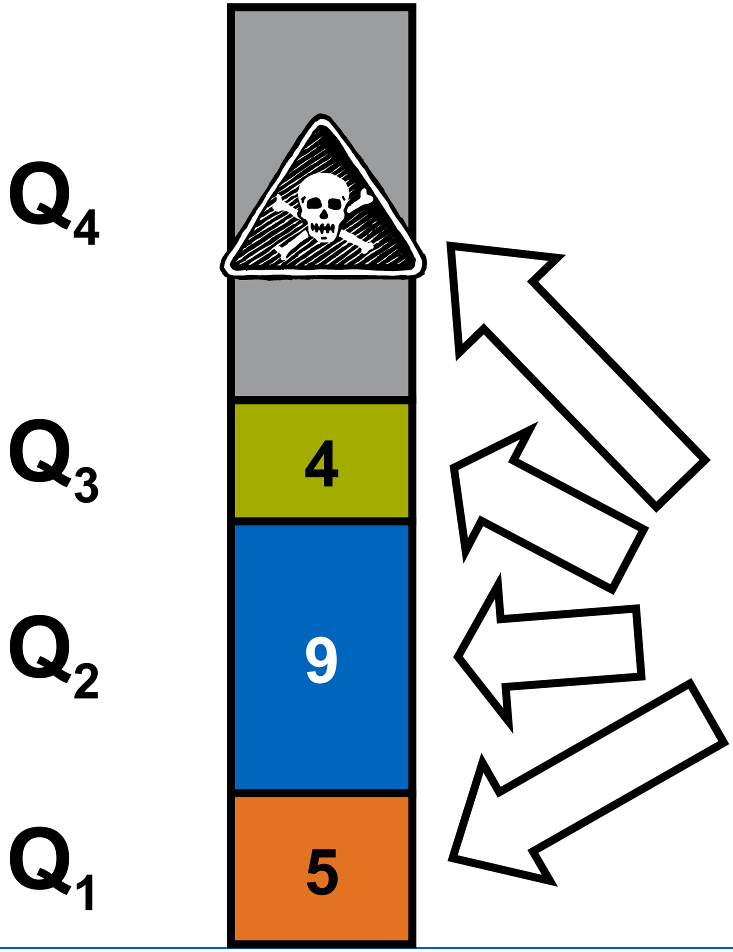

Elapsed time of queries

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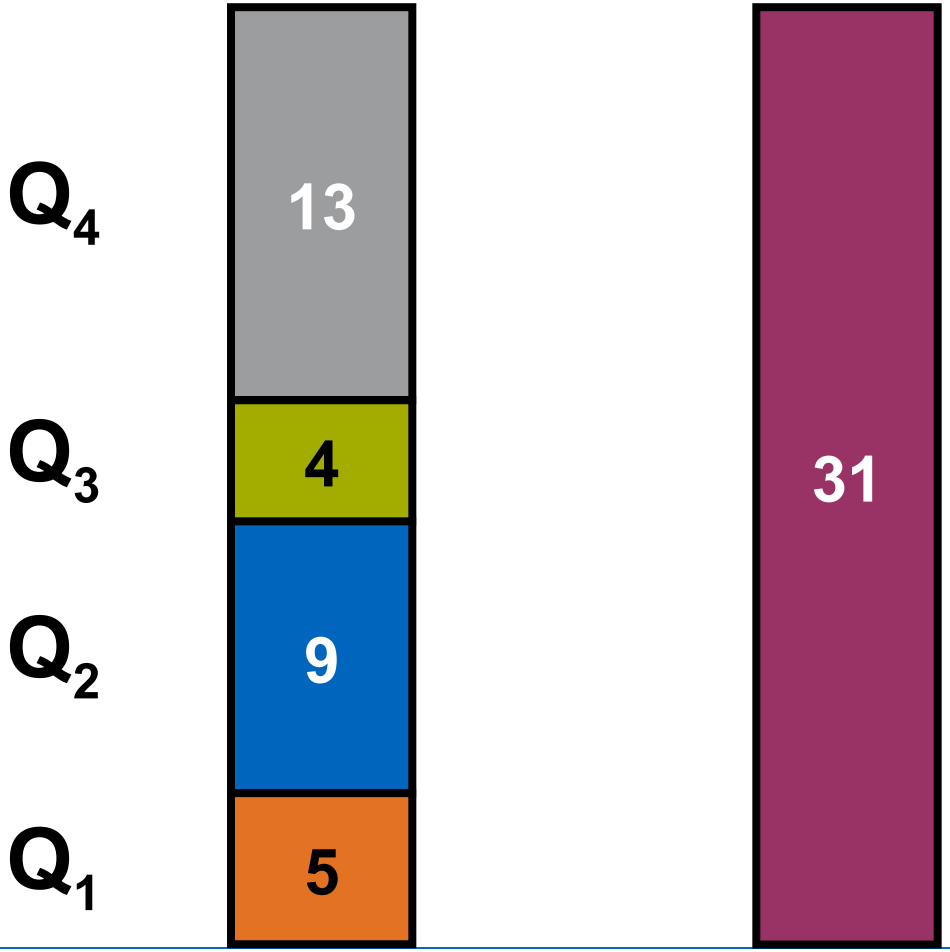
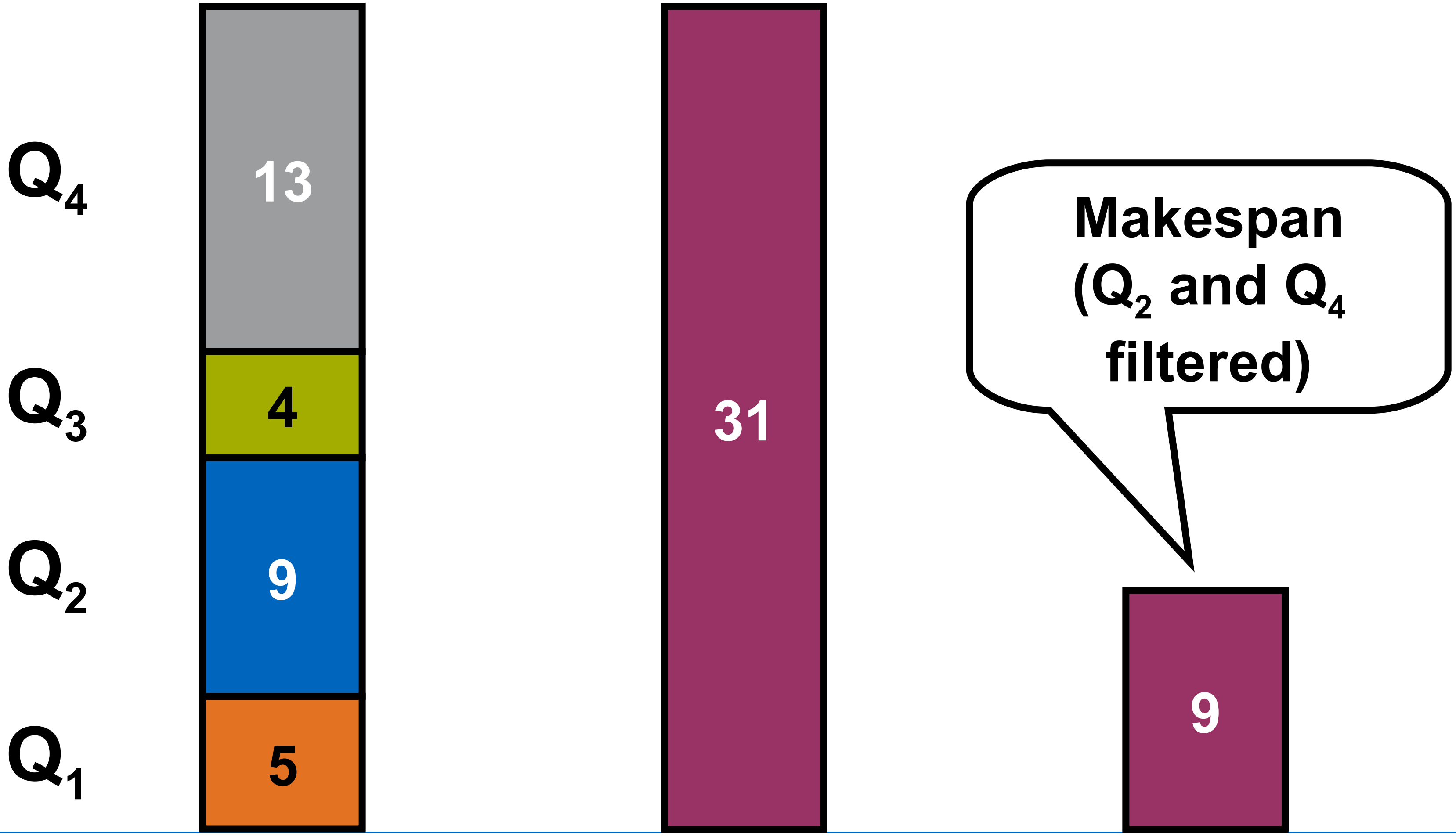


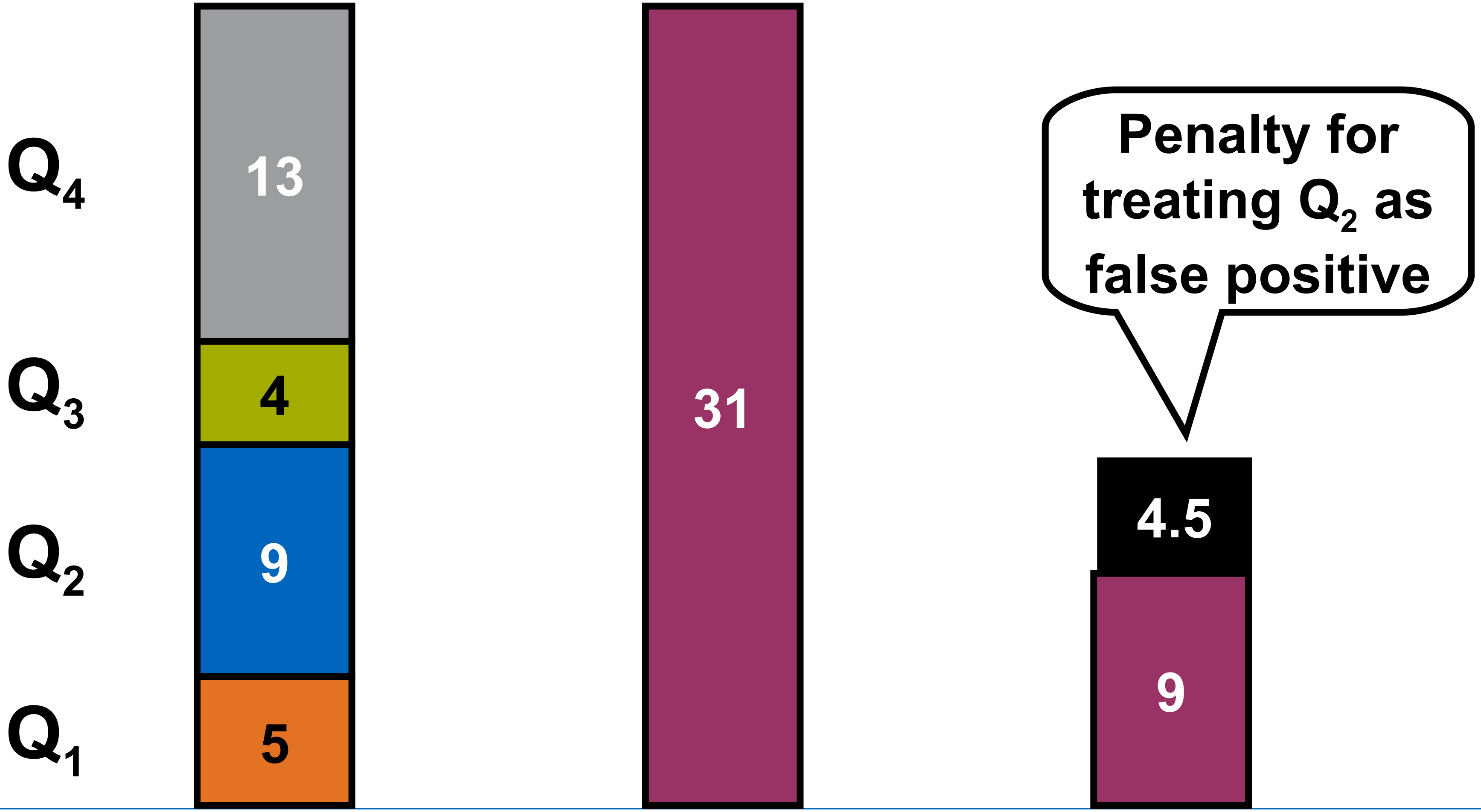
Makespan (Q_4 filtered, as expected ➔ no penalty)

Experimental measure - weighted makespan



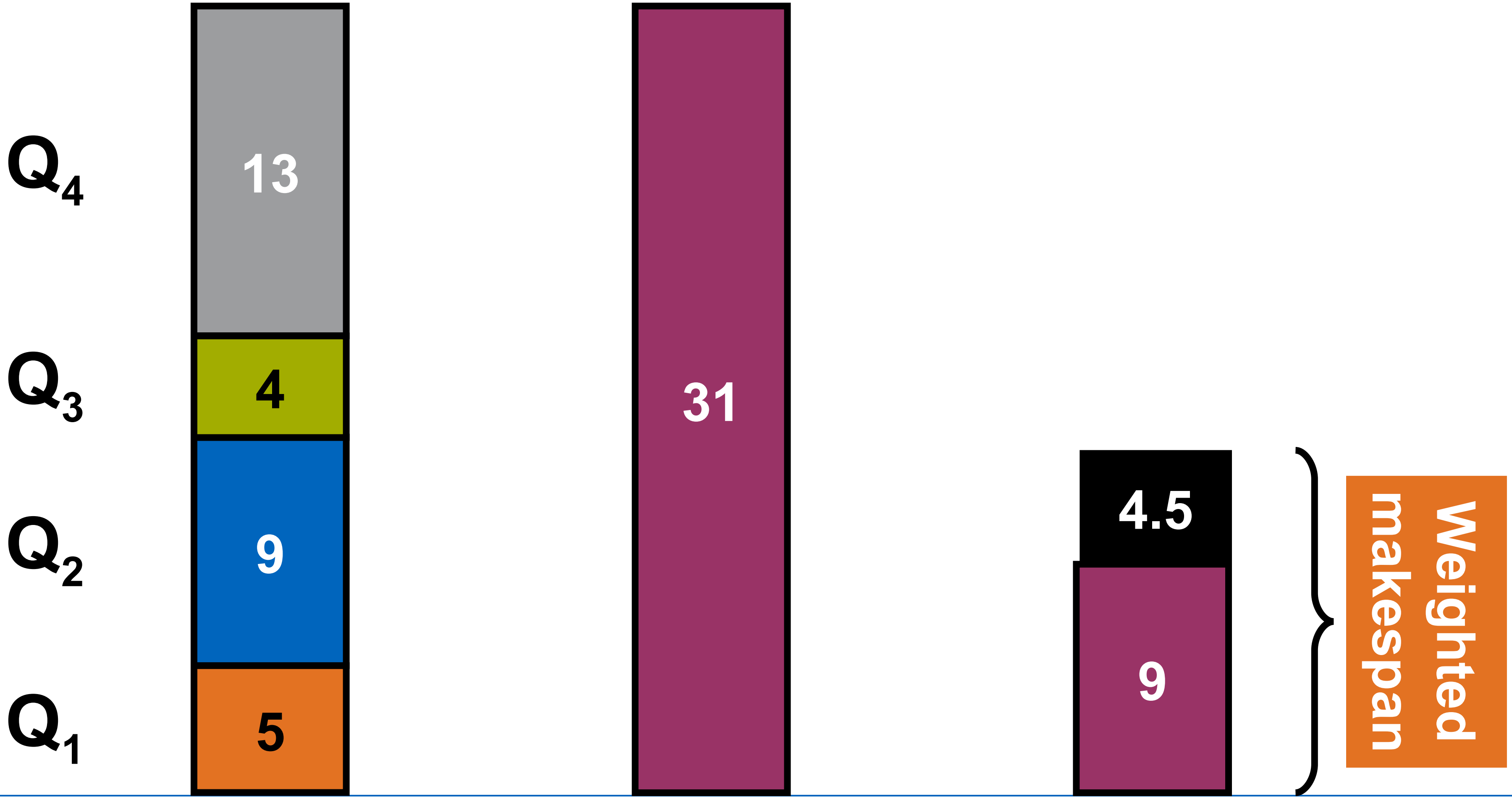
Makespan (Q_2 and Q_4 filtered)

Experimental measure - weighted makespan



Penalty for treating Q_2 as false positive

Experimental measure - weighted makespan



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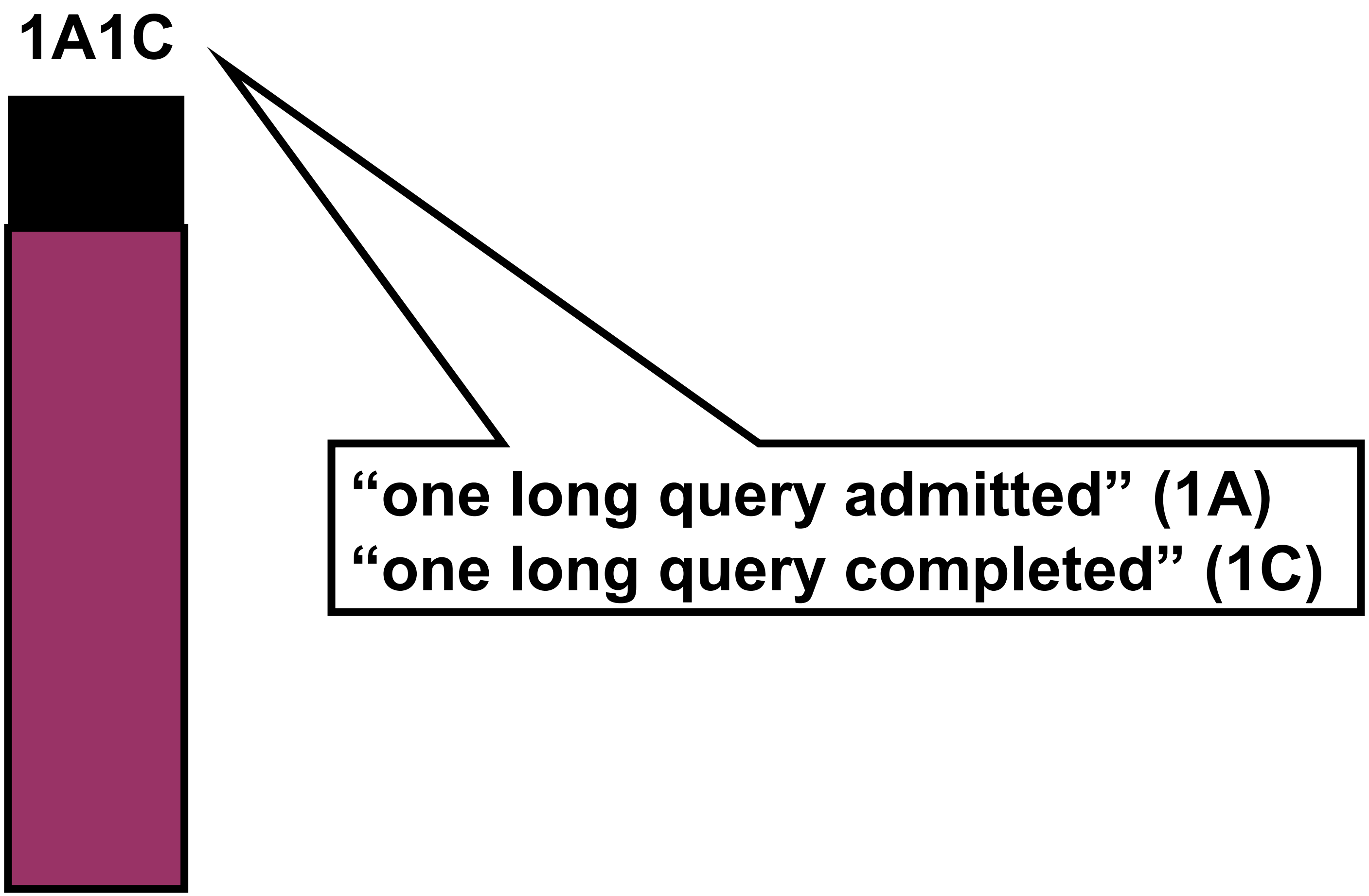
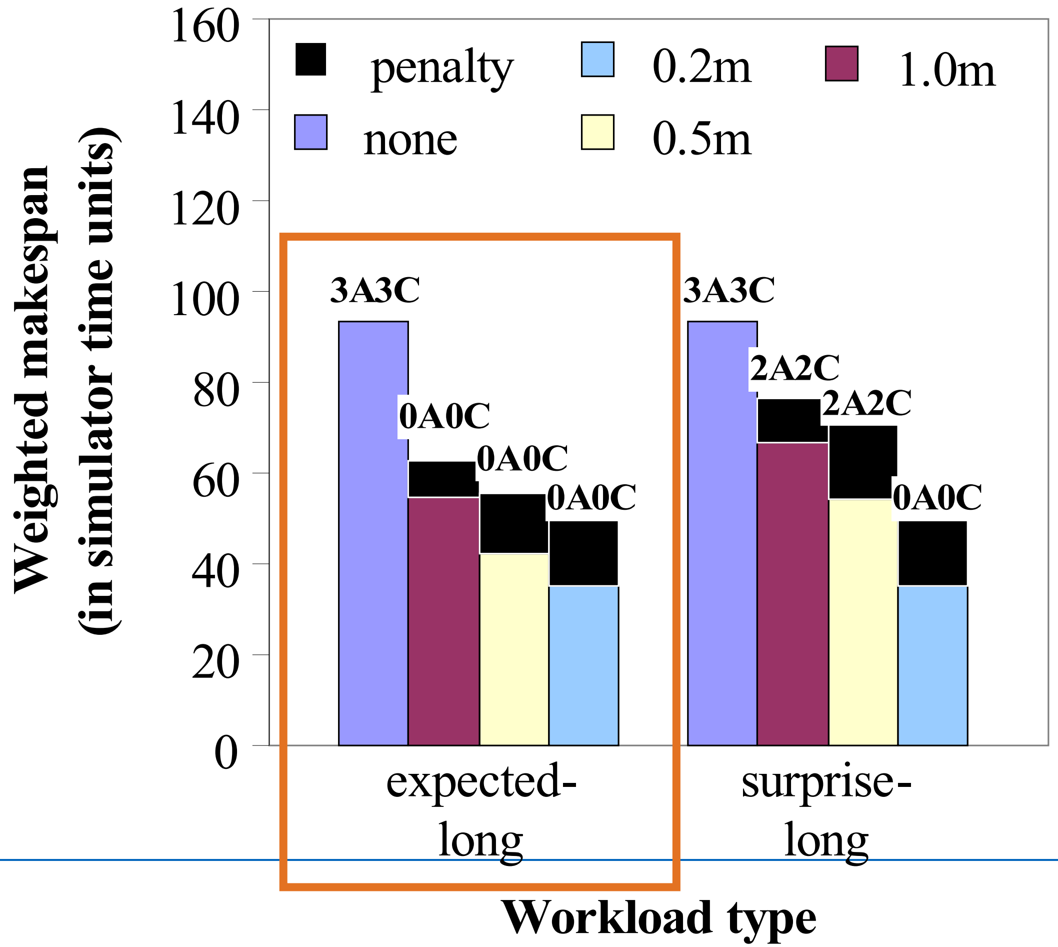


"one long query admitted" (1A)
"one long query completed" (1C)

Can WM handle unreliable cost estimates?

Admission control thresholds



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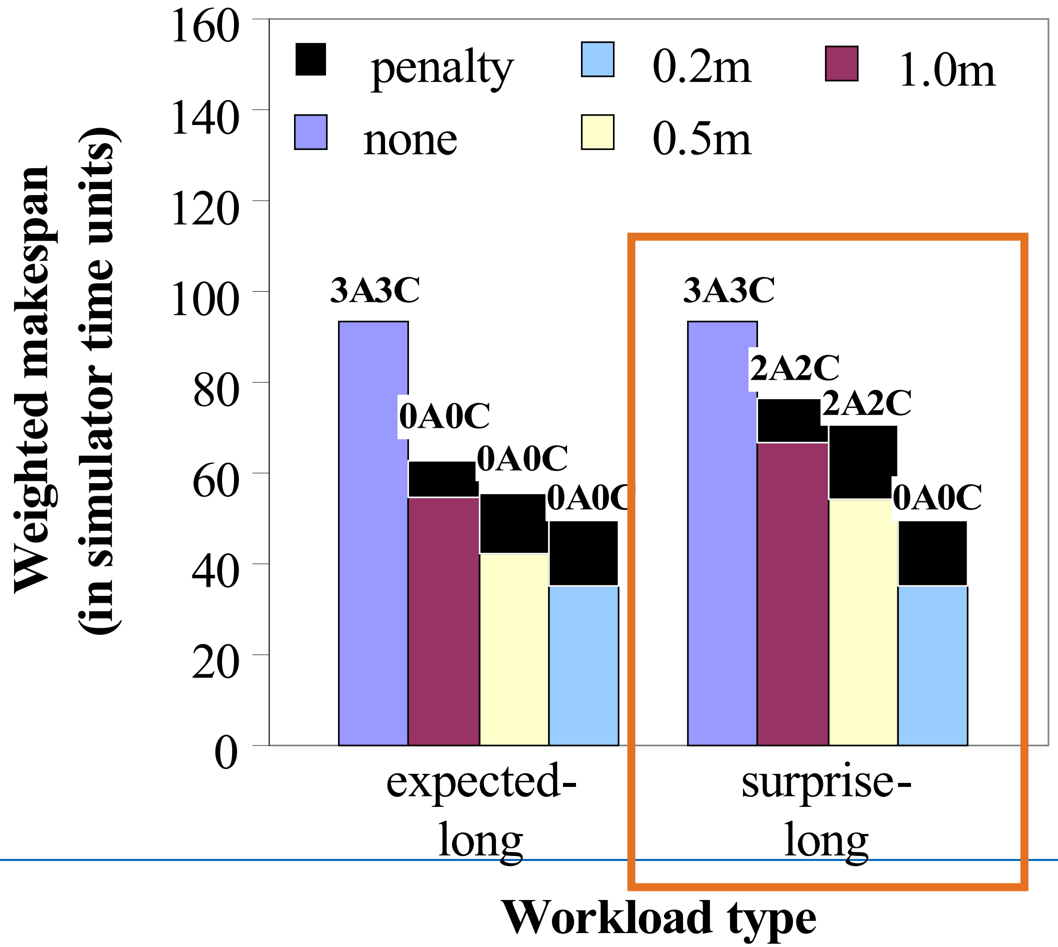

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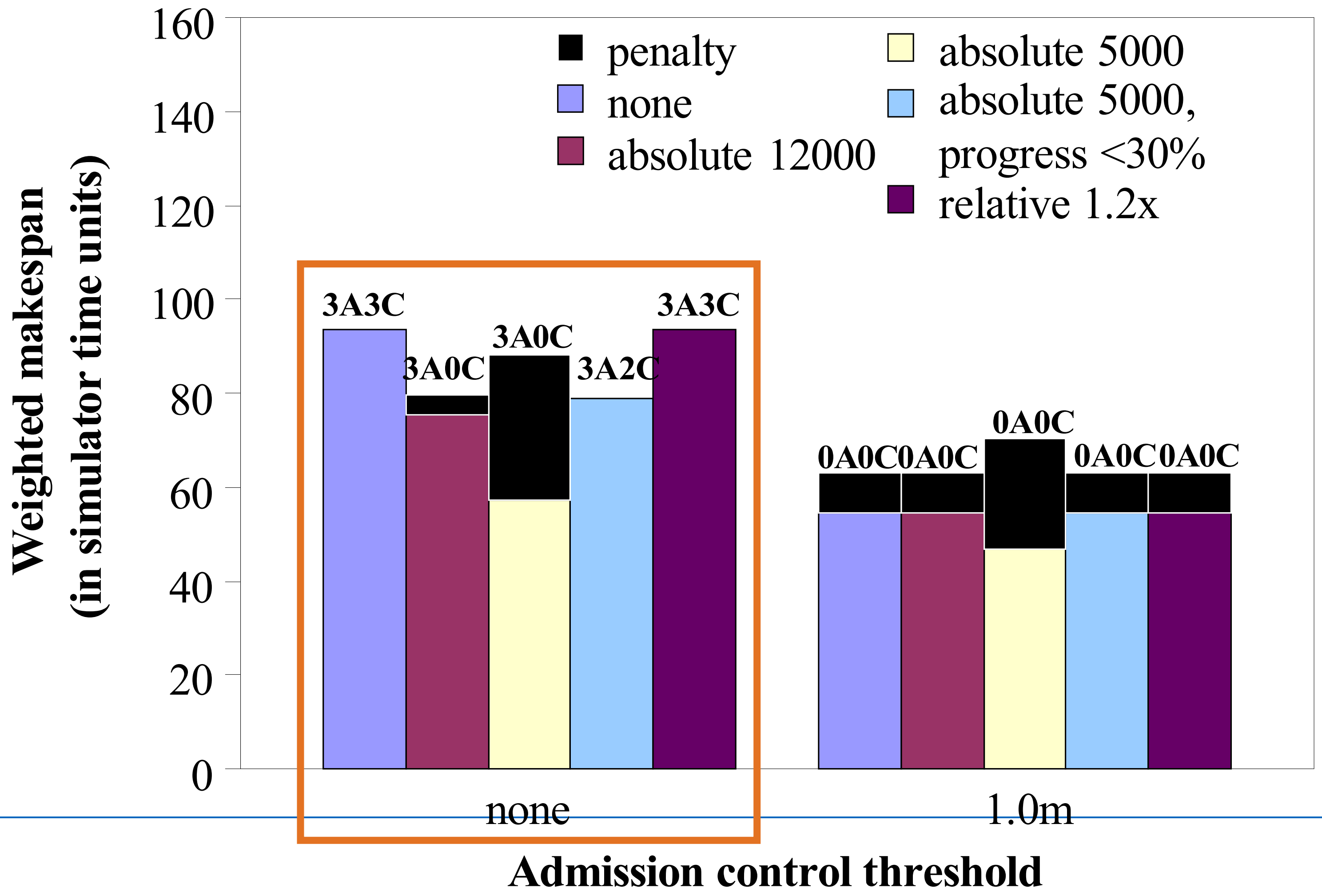
Adm ctl + exec ctl with different kill thresholds



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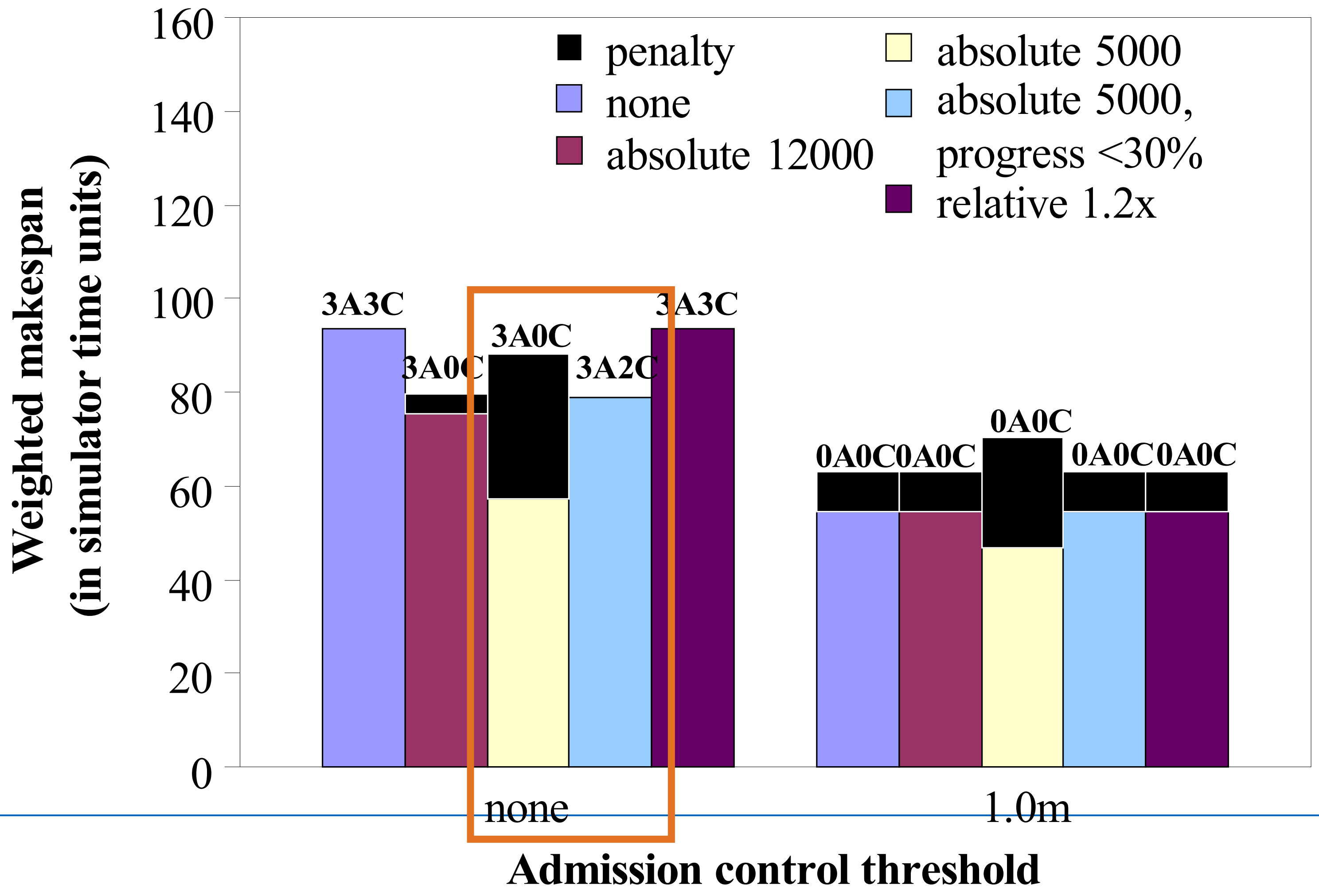

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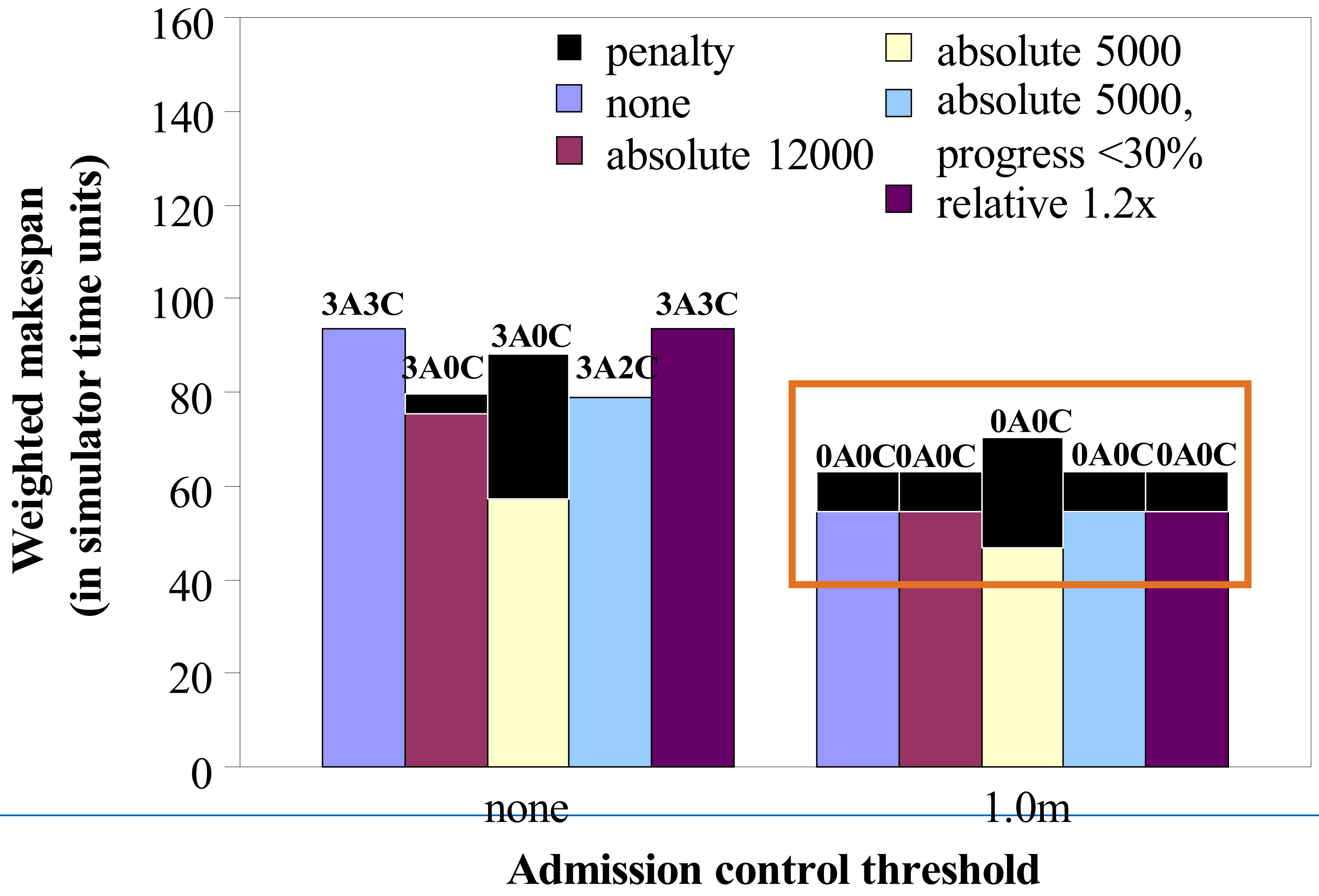

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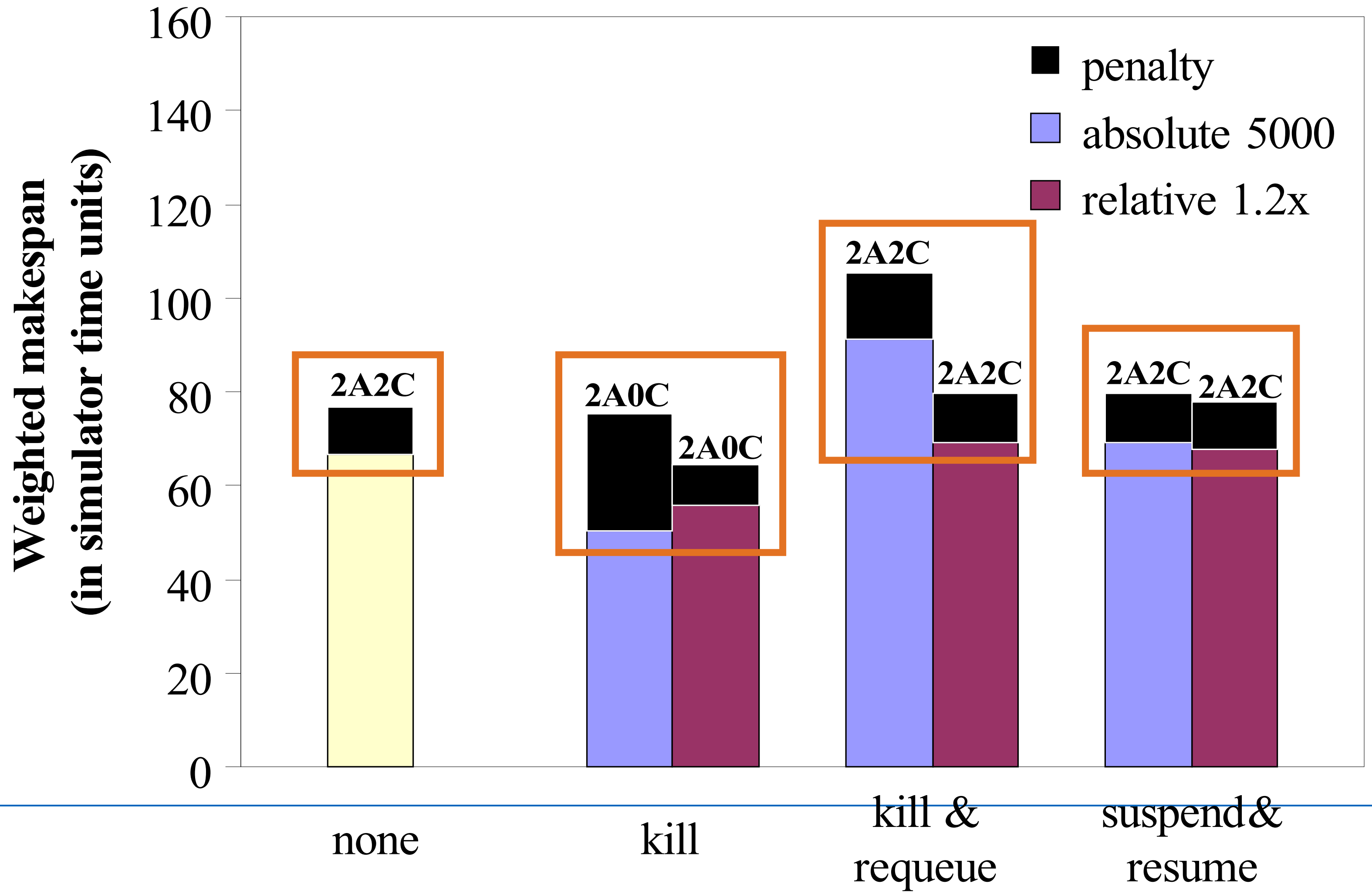
Execution control actions (w/ admission control 1.0m)



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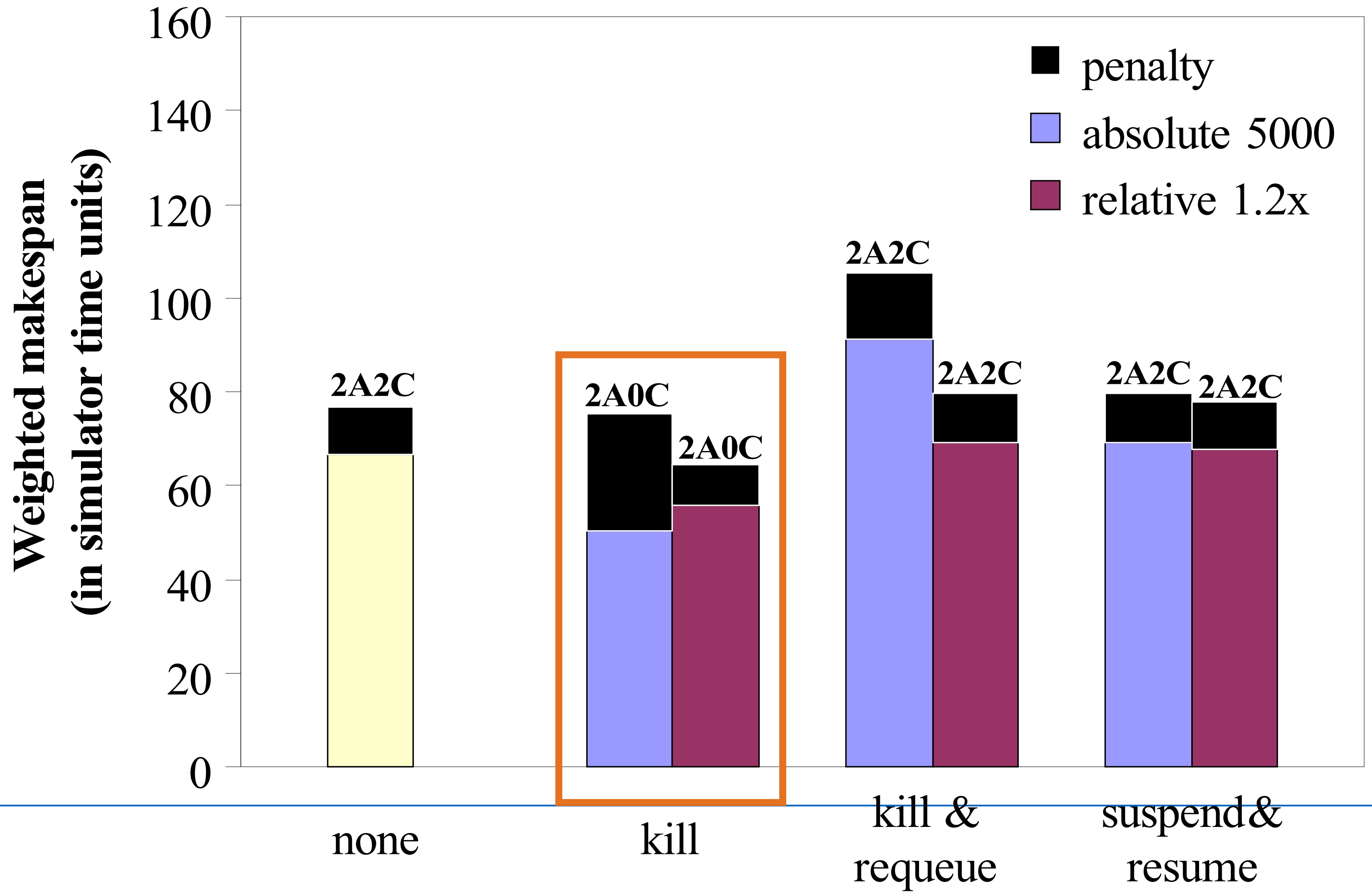

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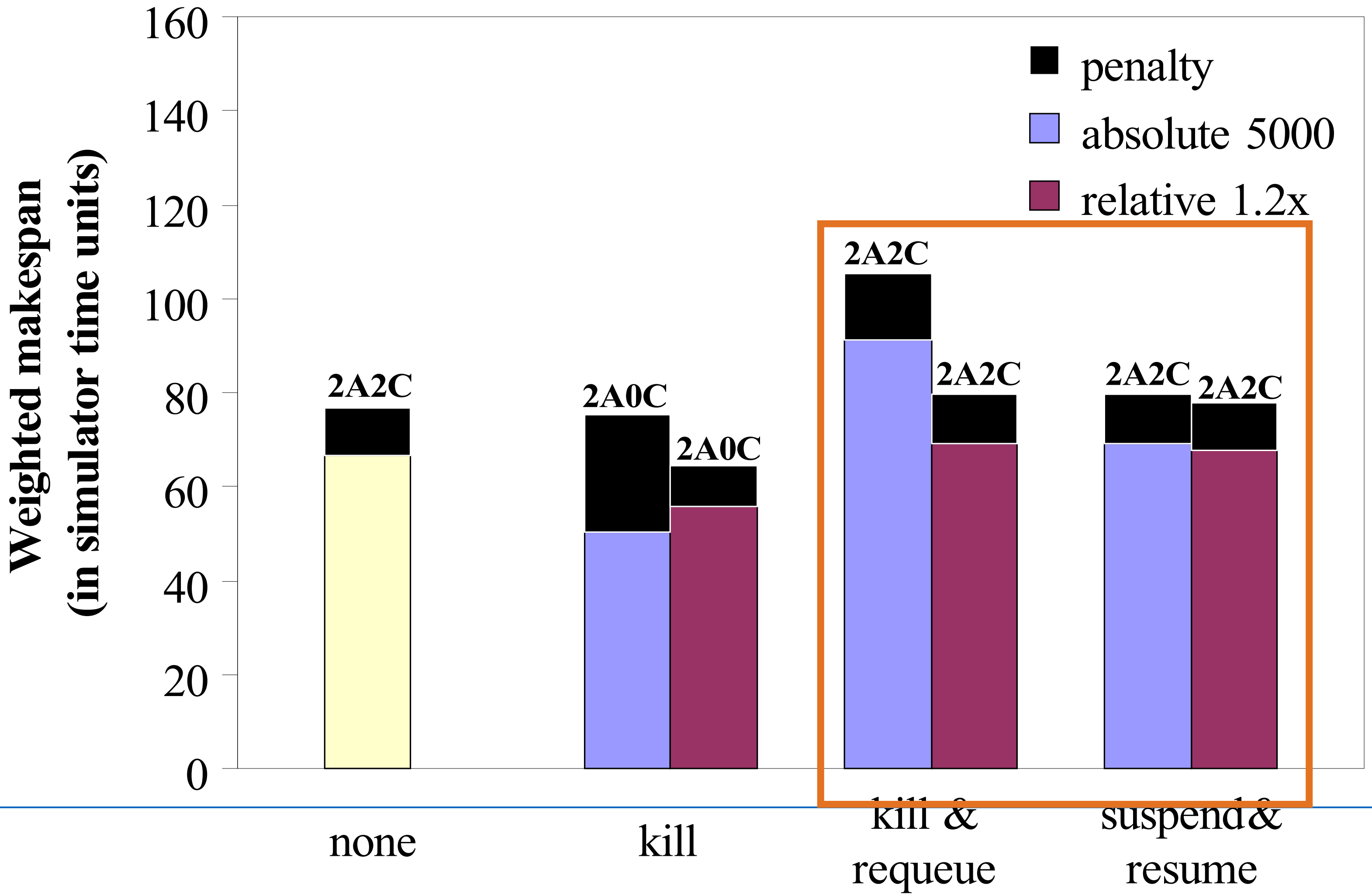
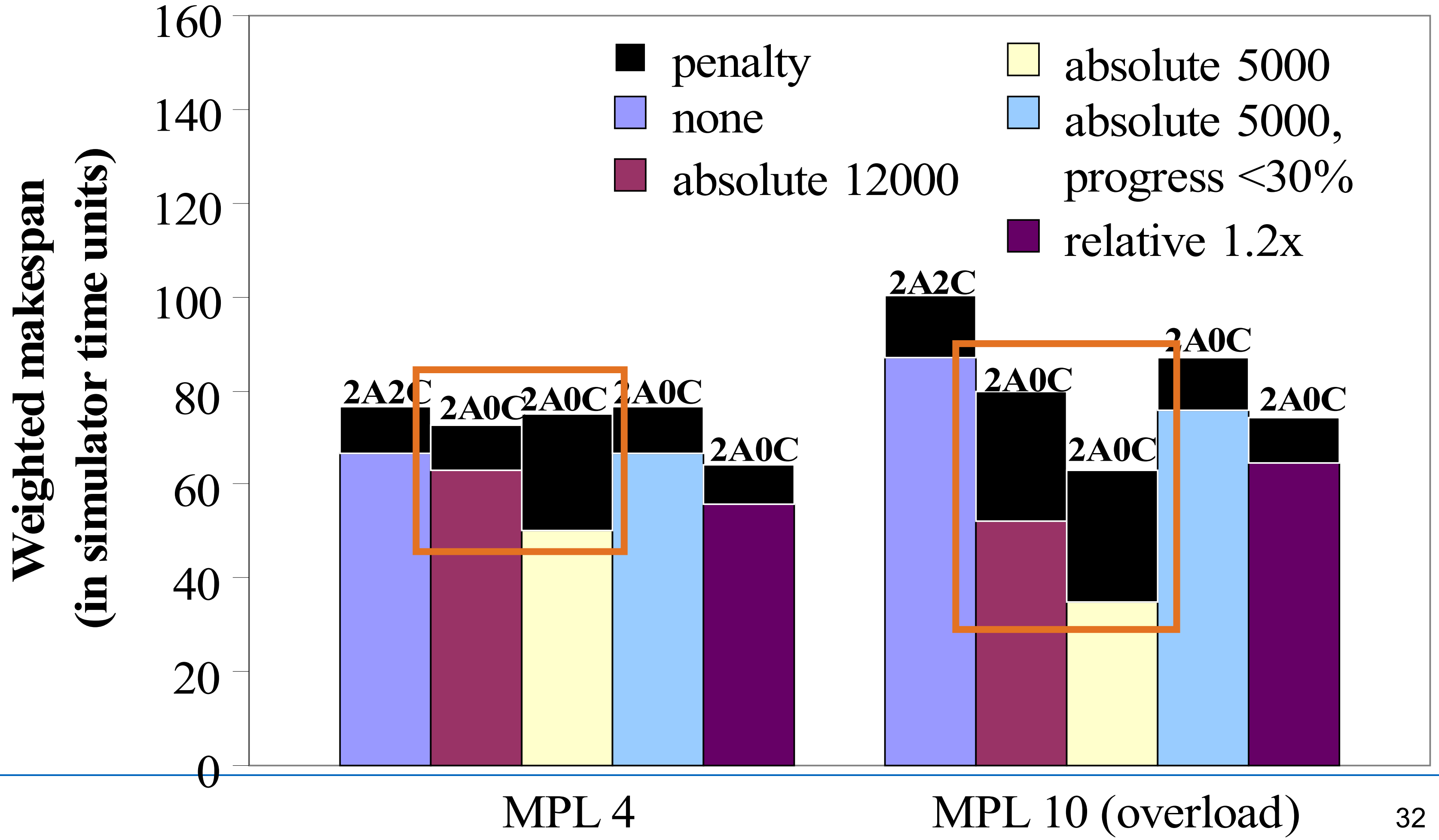


Can workload management handle system overload?



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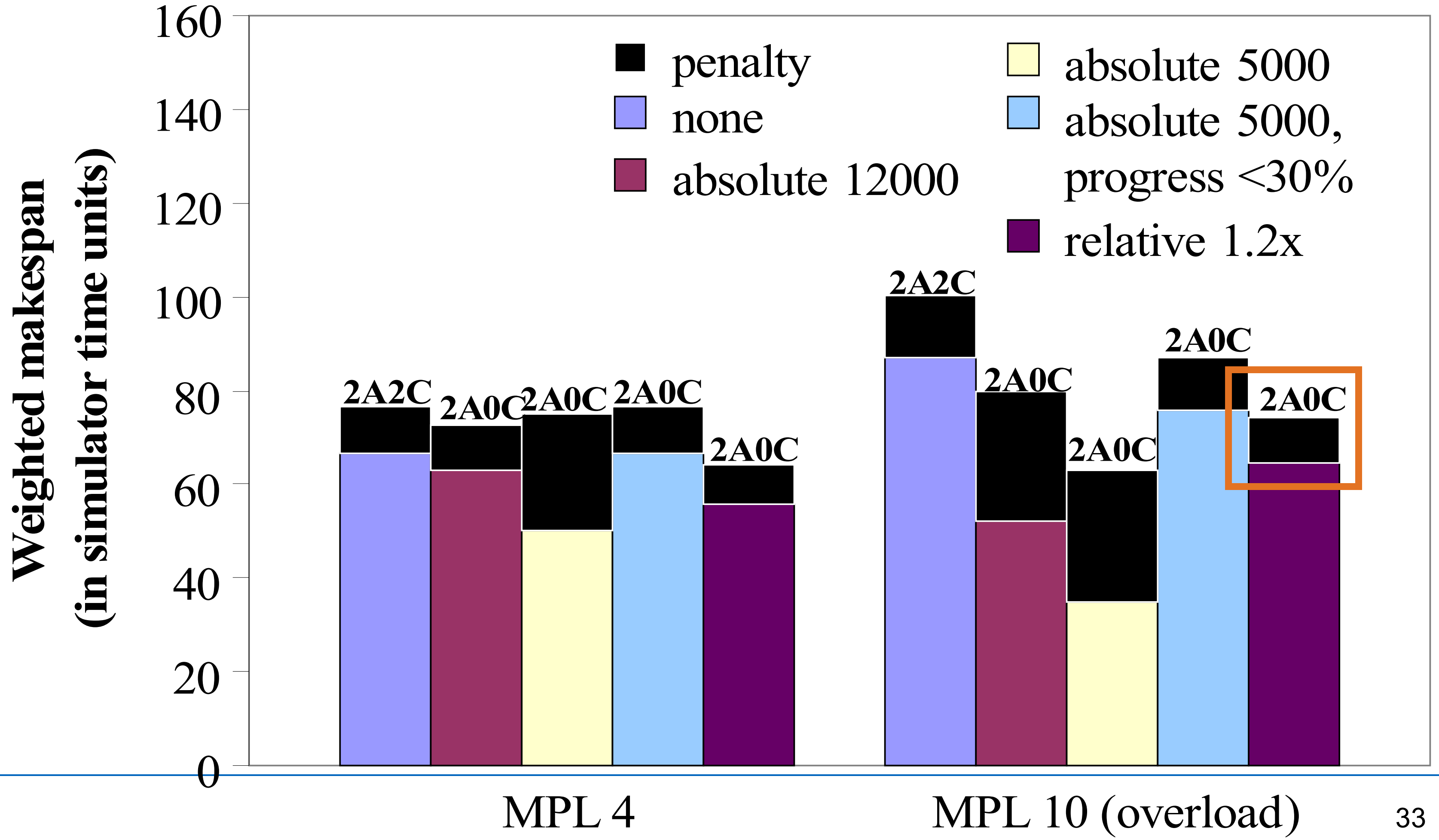

Conclusion

- Systematic study of workload management policies to mitigate the impact of long-running queries
- Can workload management handle…
  - unreliable cost estimates ✓
  - unobserved resource contention ✓
  - system overload ✗

- Value of this work: experimental framework for studying more challenging workload management problems

Related work (excerpt)

D. G. Benoit. *Automated Diagnosis and Control of DBMS Resources*. EDBT PhD. Workshop, 2000

S. Chaudhuri, R. Kaushik, and R. Ramamurthy. *When Can We Trust Progress Estimators for SQL Queries?* SIGMOD 2005

S. Chaudhuri, R. Kaushik, R. Ramamurthy, and A. Pol. *Stop-and-Restart Style Execution for Long Running Decision Support Queries*. VLDB 2007

S. Krompass, H. Kuno, U. Dayal, and A. Kemper. *Dynamic Workload Management for Very Large Data Warehouses: Juggling Feathers and Bowling Balls*. *VLDB* 2007

G. Luo, J. F. Naughton, and P. S. Yu. *Multi-query SQL Progress Indicators*, EDBT 2006

Workload management tools: HP Neoview, IBM Workload Manager for DB2, Microsoft SQL Server, Oracle Database Resource Manager, Teradata Dynamic Workload Manager