Partitioning Strategies for Distributed SMT Solving

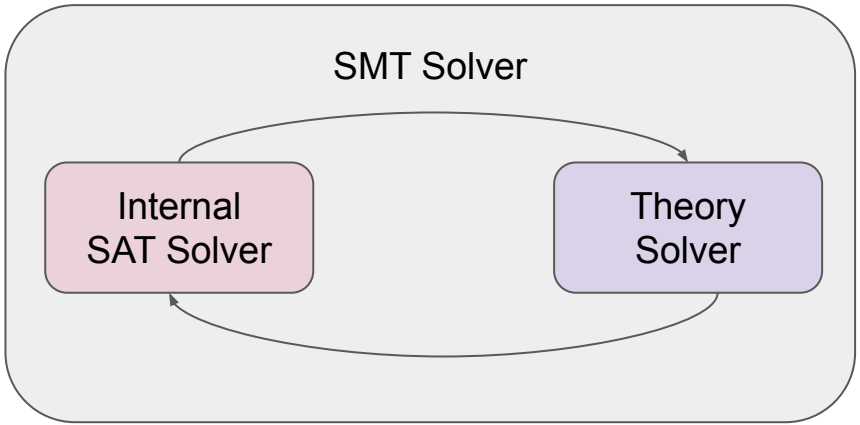
Amalee Wilson

Boolean Abstraction of a Math Problem

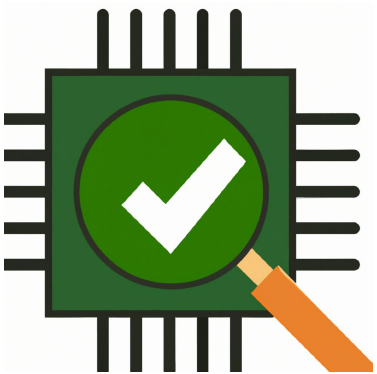
x > 50 or y = 12

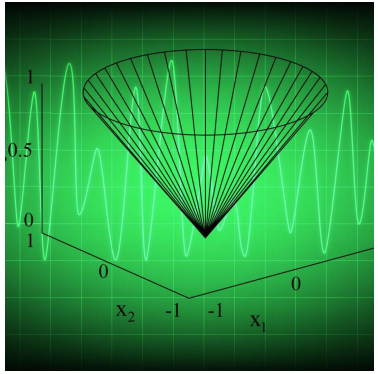
x + y > 100

(a ∨ b)∧ (e)

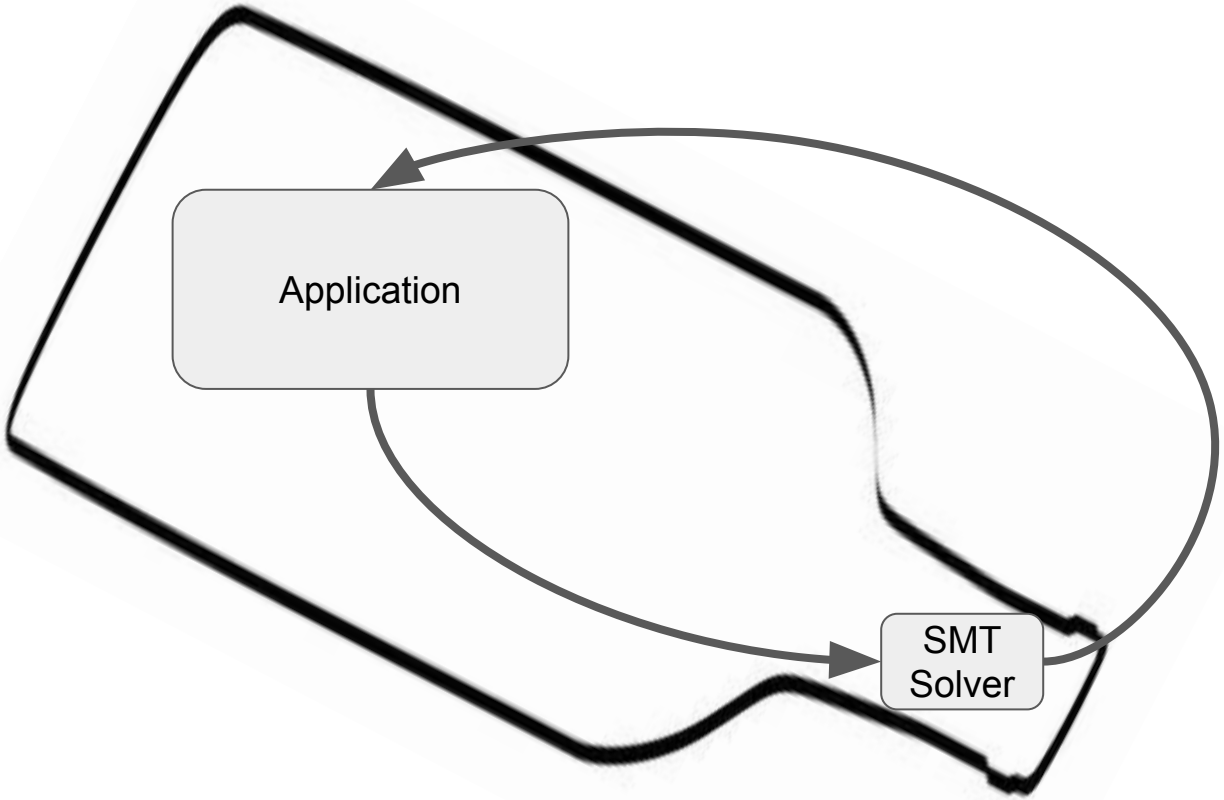


Why Use Satisfiability Modulo Theories (SMT) Solvers?

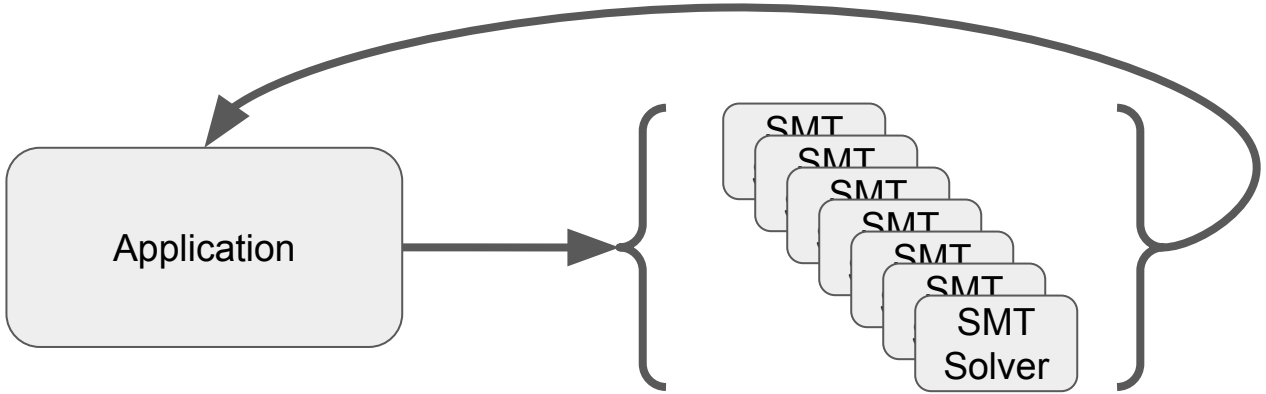




SMT Performance Bottleneck



Portfolio Solving



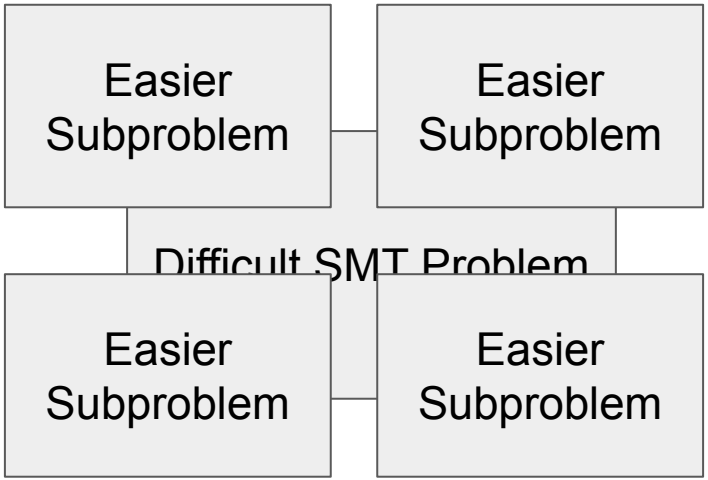
* limited by best sequential performance

Portfolio Solving

We can do better!

* limited by best sequential performance

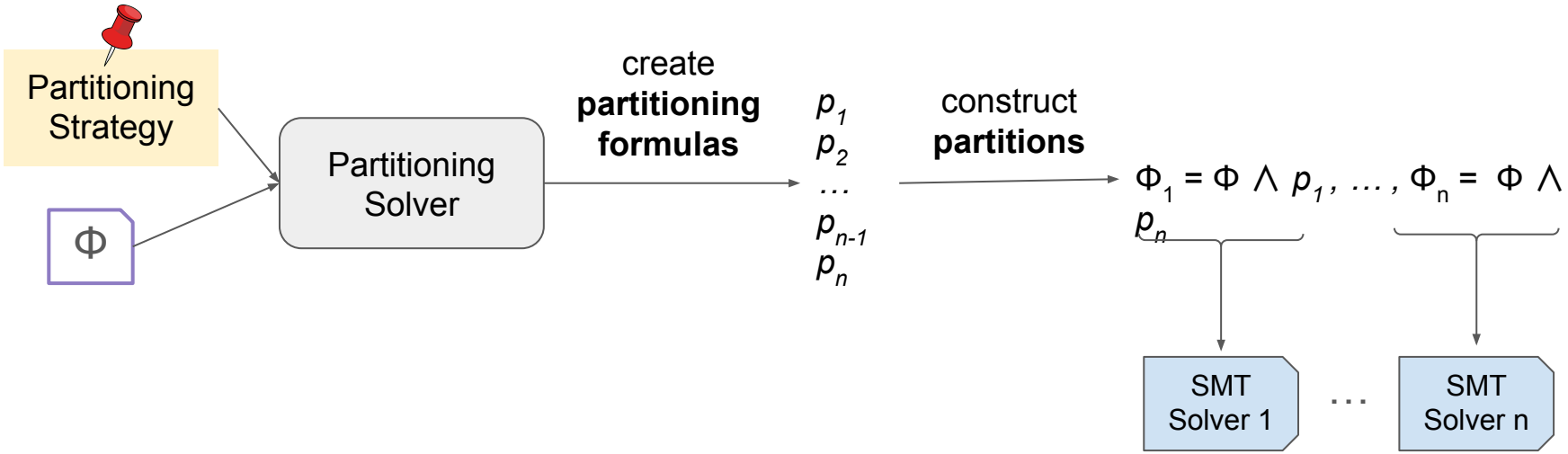
Partitioning



Outline

- Partitioning Strategies
- Evaluation and Advanced Portfolio Techniques

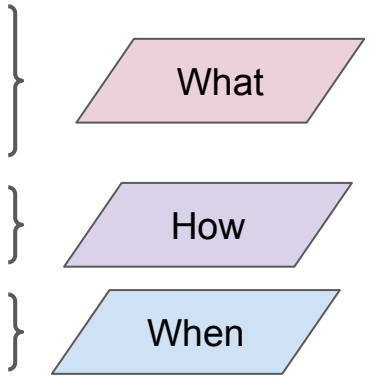
Parallel SMT Solving with Partitioning



Partitioning Strategy Parameters

Four Dimensions

1. Atom source
2. Atom selection heuristic
3. Partition type
4. Partition timing



Evaluation

- 214 challenge benchmarks

Partitioning Strategy Parameters

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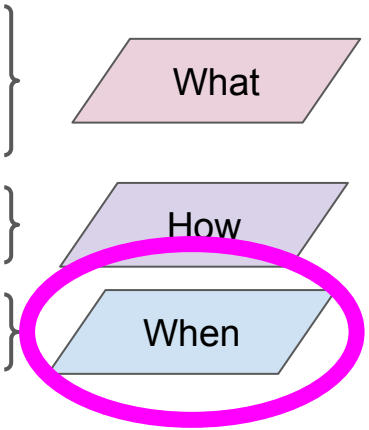


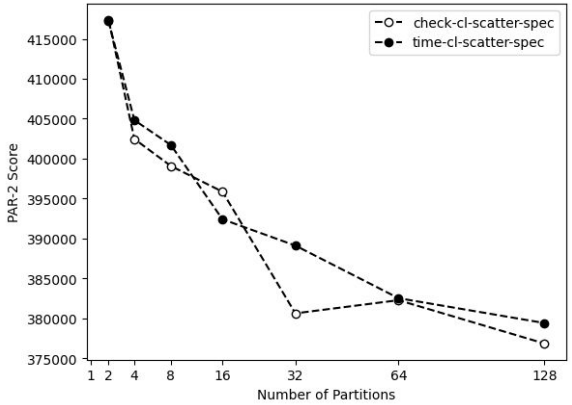
Partition Timing - Wait 3 Seconds

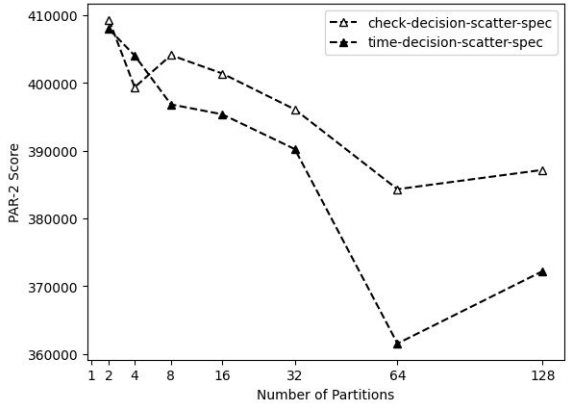
PAR-2: (sum of solved runtimes) + 2*(timeout)*(# unsolved)

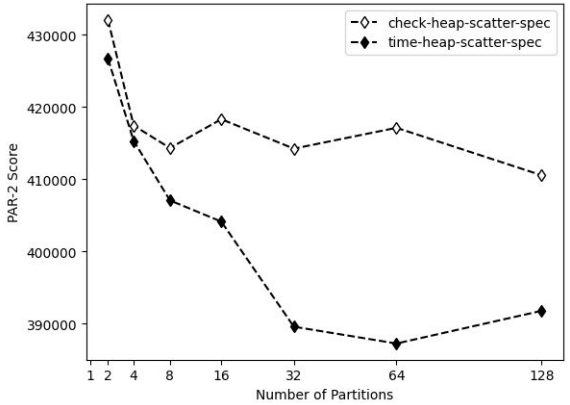
Time	Solved	PAR-2
1s	40	223636
3s	42	219187
15s	42	219313

Note: this is on a subset of benchmarks, all other experiments use all 214

Partition Timing - Use a Timer







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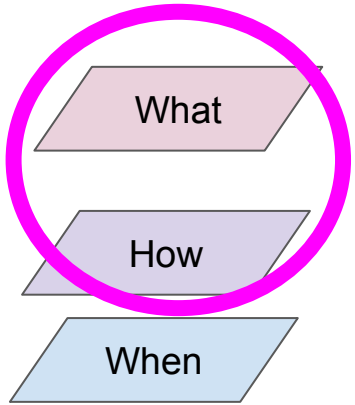
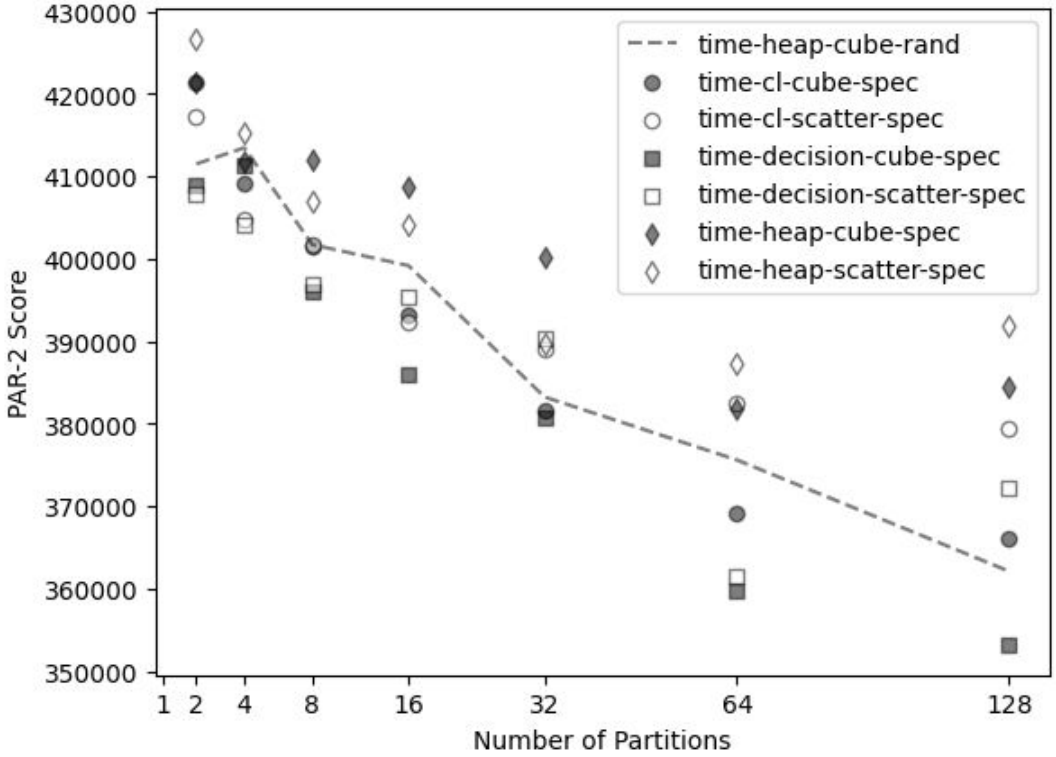
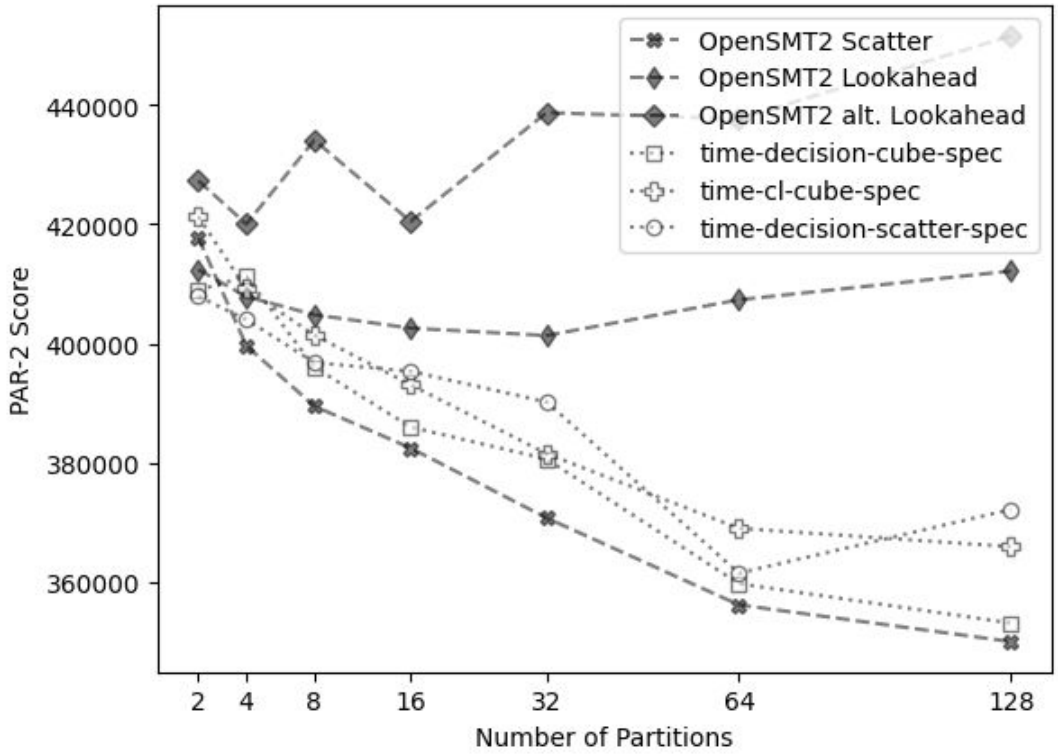


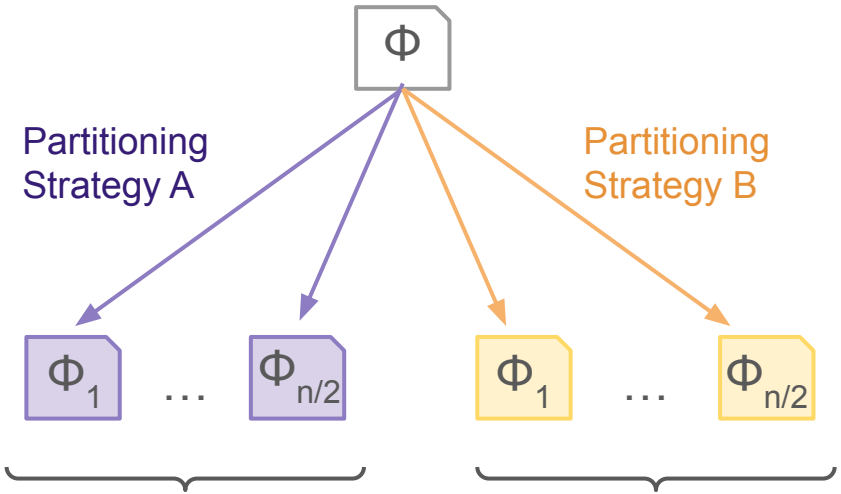
Random is Better than Some Strategies



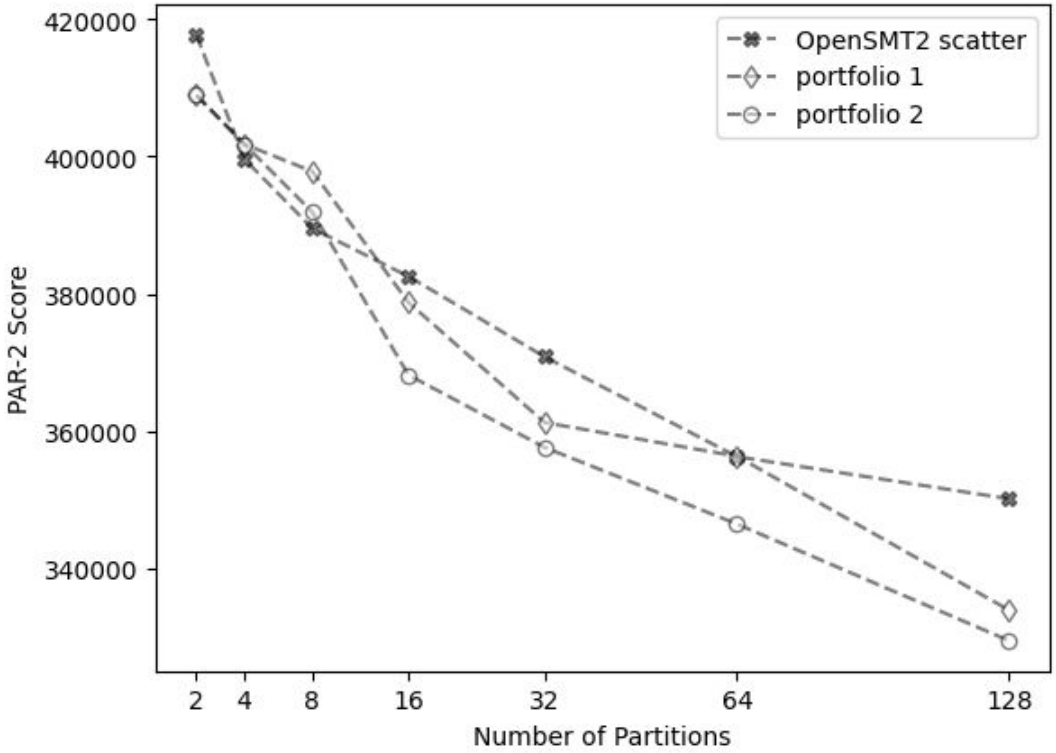
OpenSMT2 is Better at Scattering



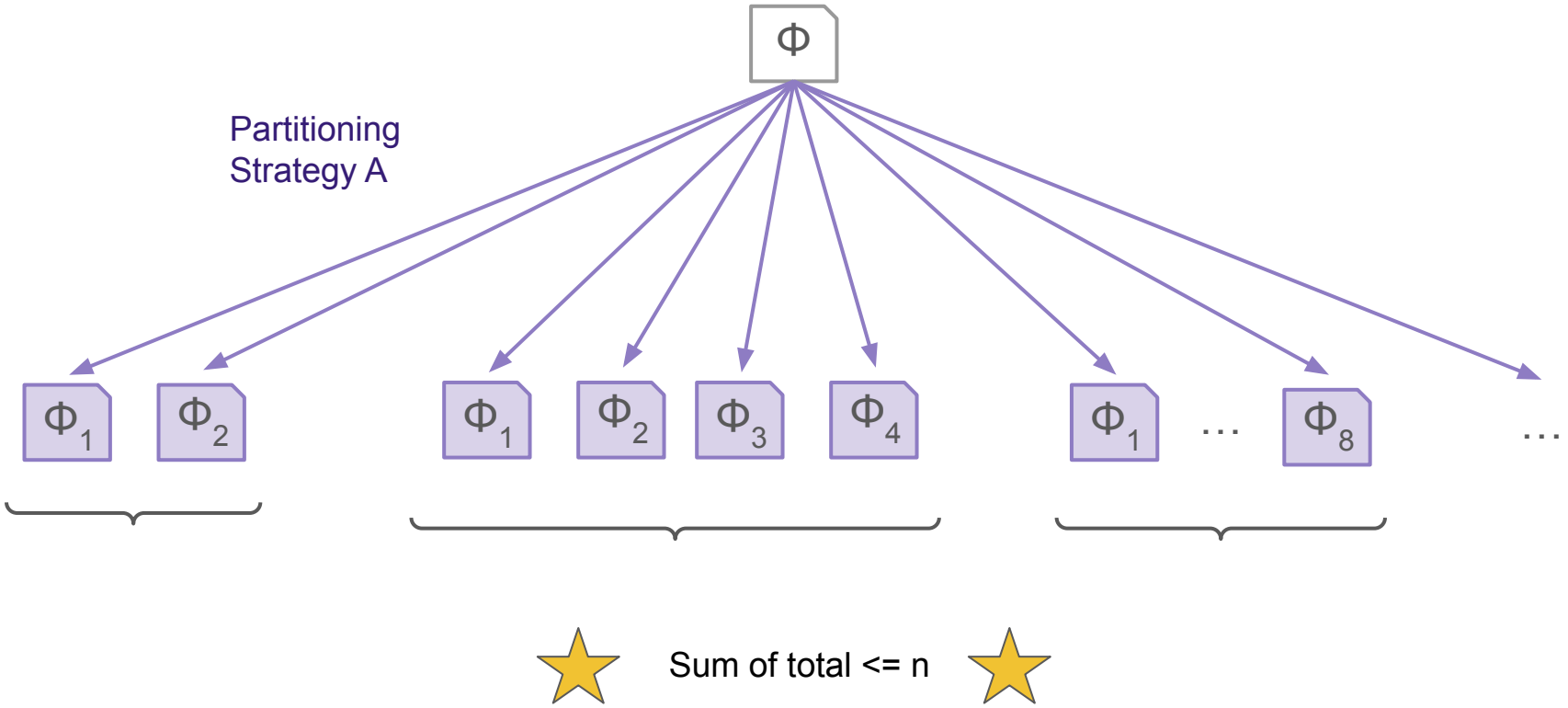
How to Make a Partitioning Portfolio



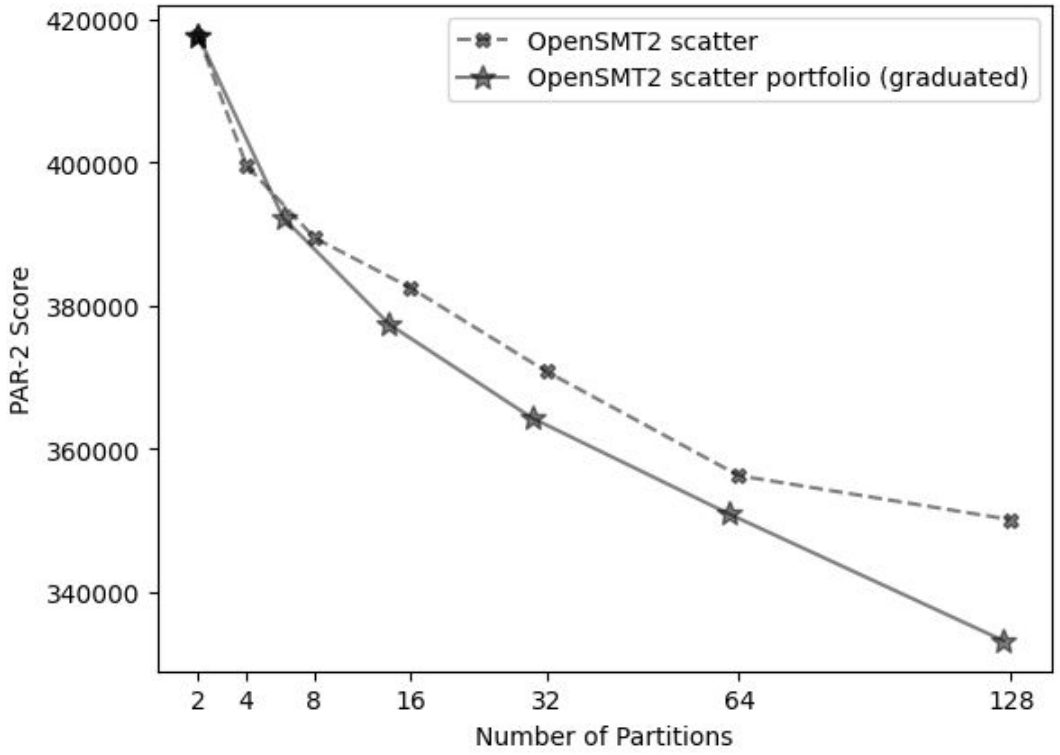
Partitioning Portfolios Improve Performance



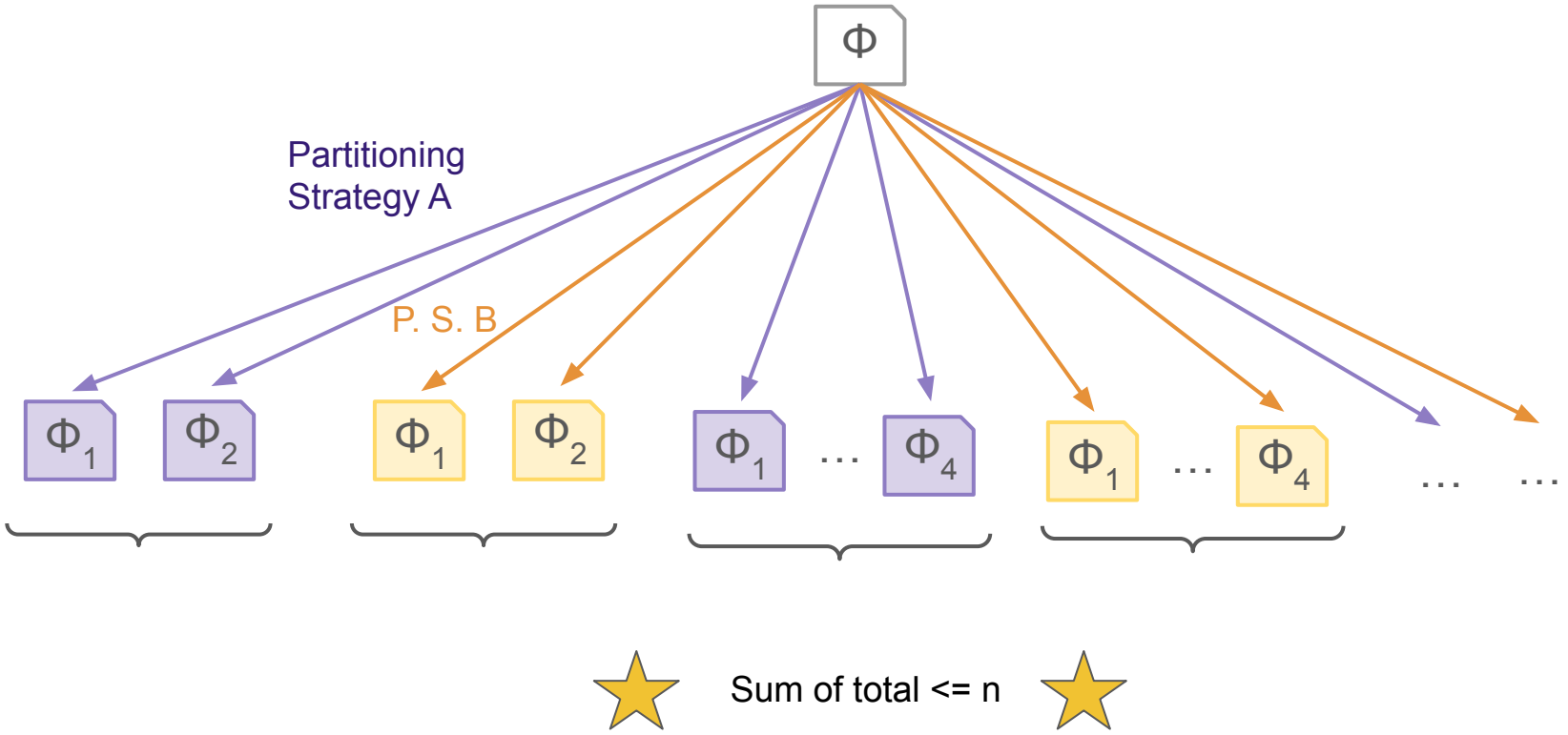
How to Make a Graduated Portfolio



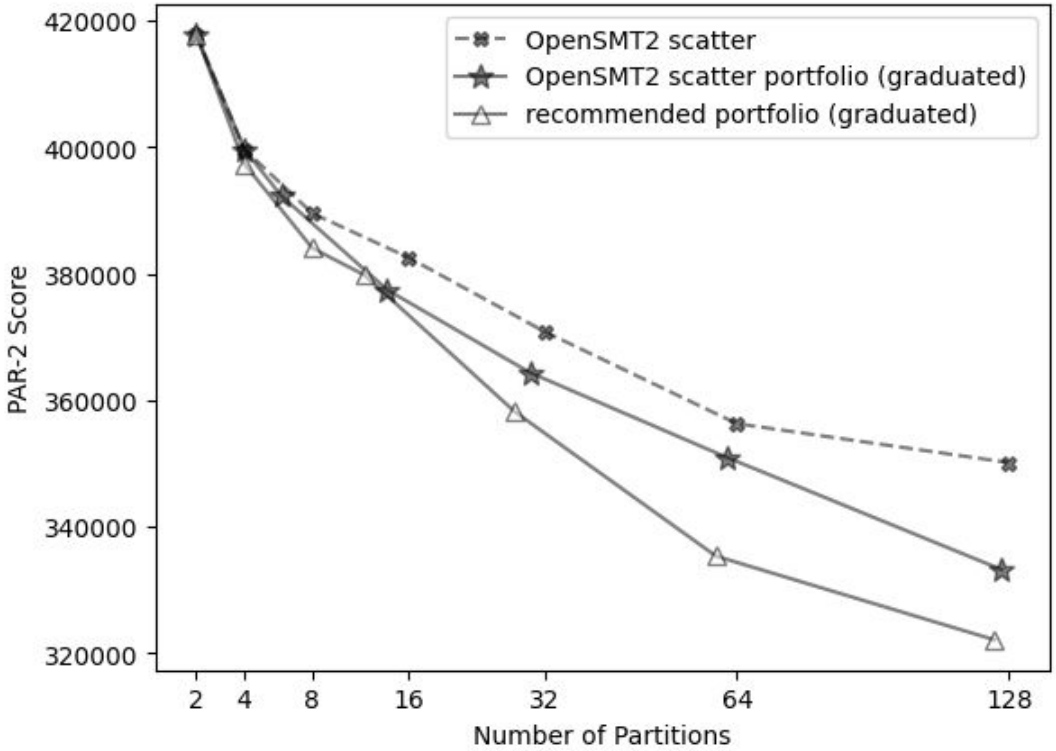
Graduated Portfolio Improves a Single Strategy



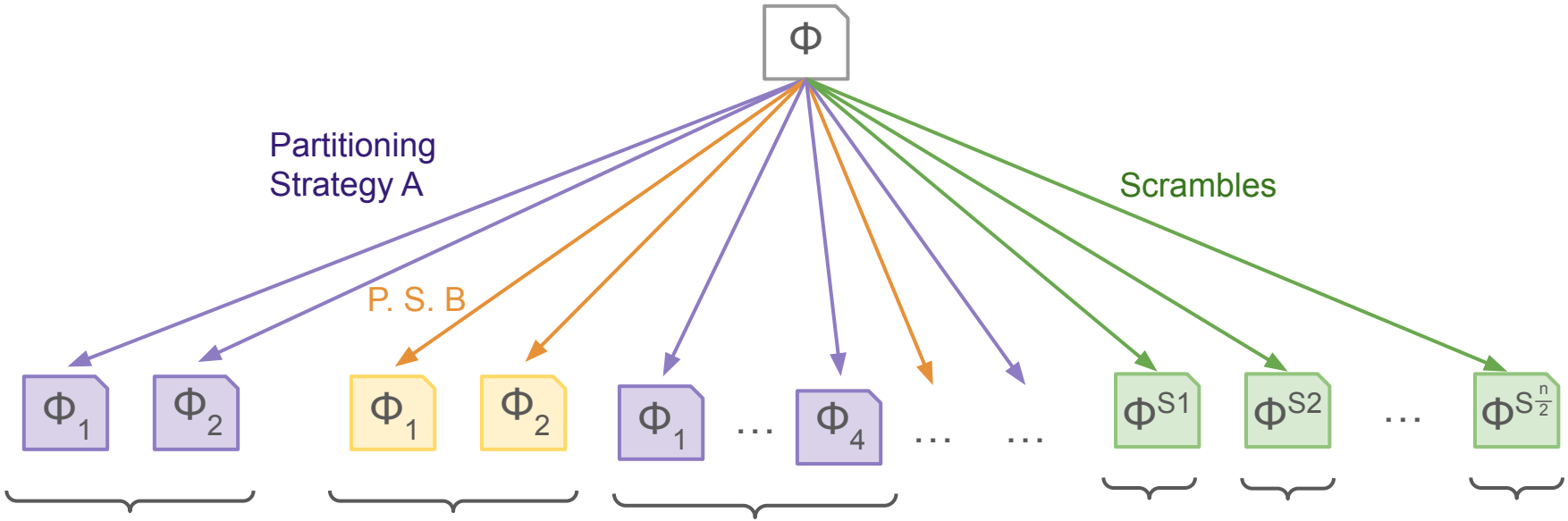
How to Make the Recommended Portfolio



Evidence to Support Recommended Portfolio

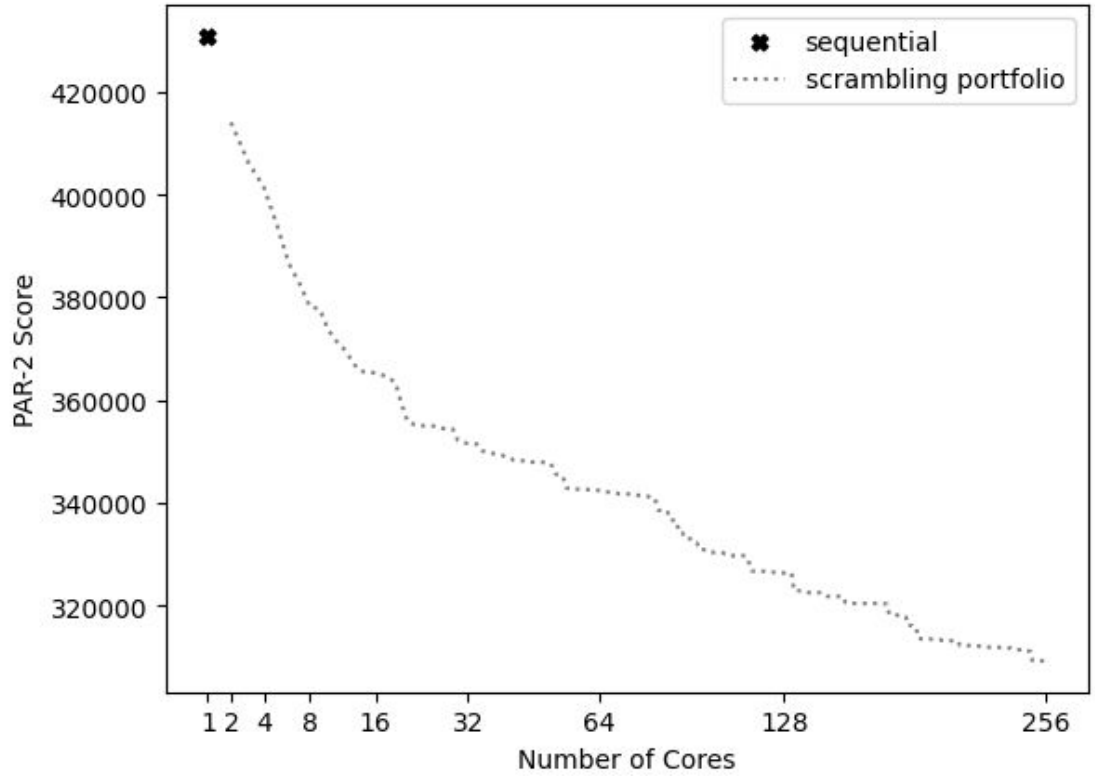


How to Make a Hybrid Portfolio



Sum of total = n

Partitioning Can Help Us Do Better than Regular Portfolio



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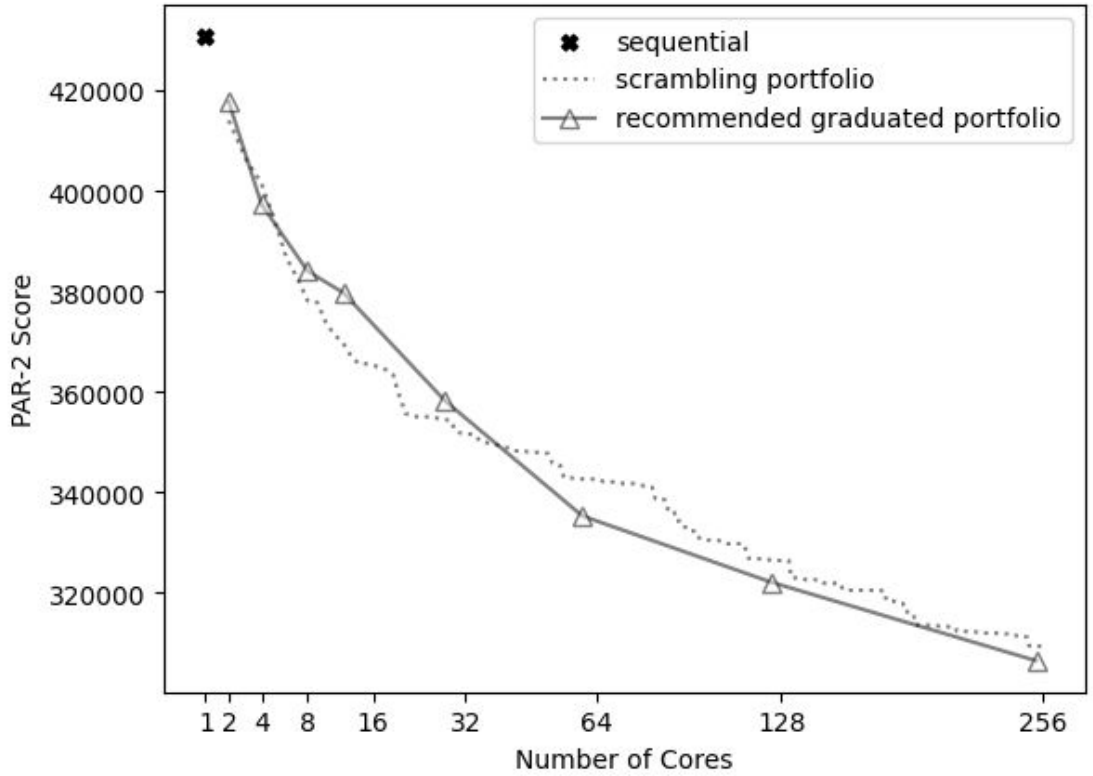

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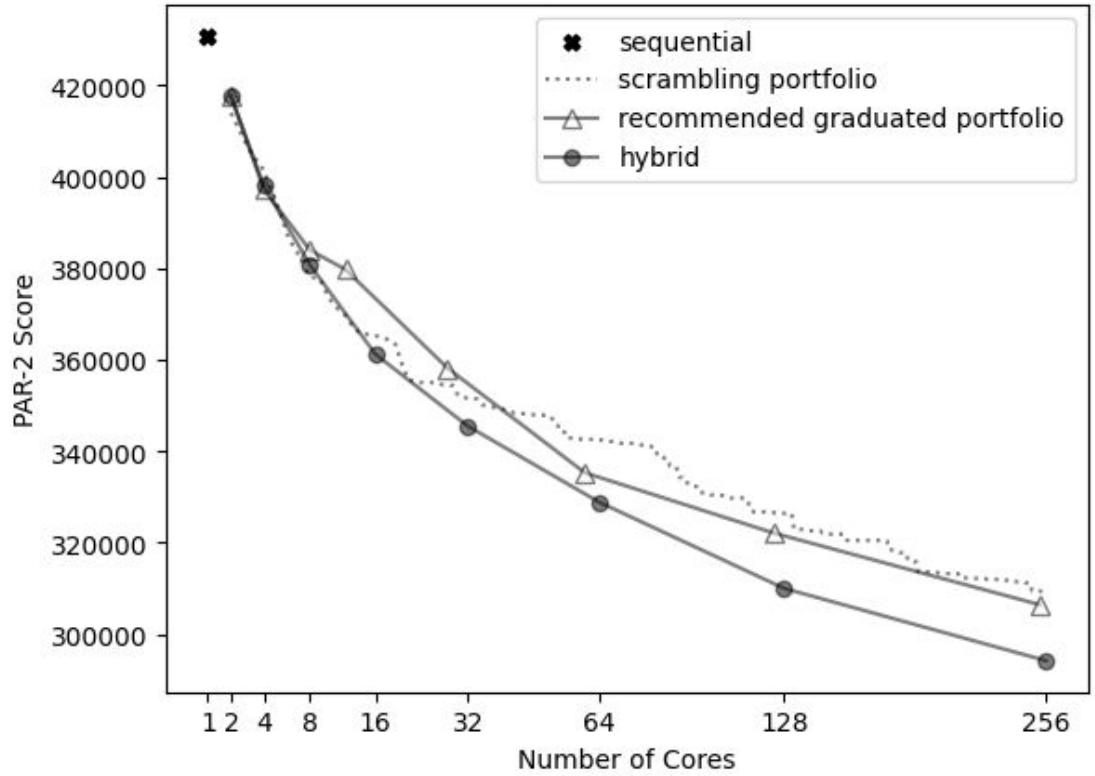

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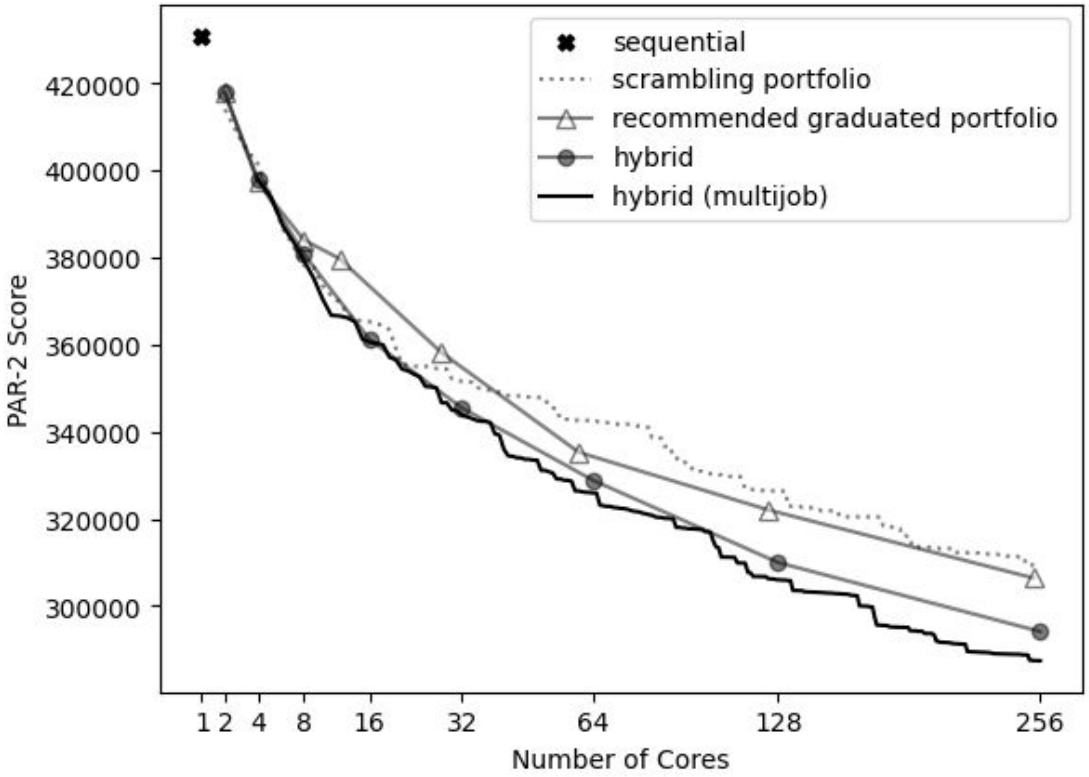

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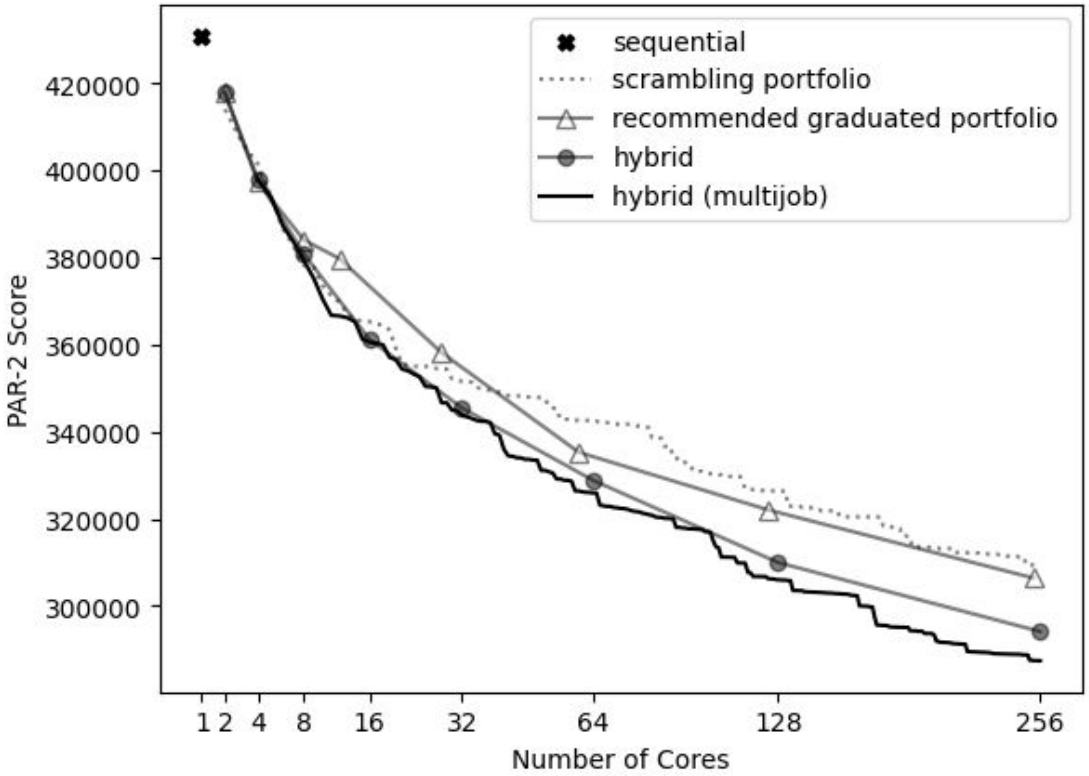

Strategy	# Solved
Sequential	54
Standard Portfolio	107
Recommended Portfolio	109
Hybrid	112
Multijob	114