Fast Downward Stone Soup: A Baseline for Building Planner Portfolios

Paper by:

Helmert, Roger, and Karpas

Presentation by:

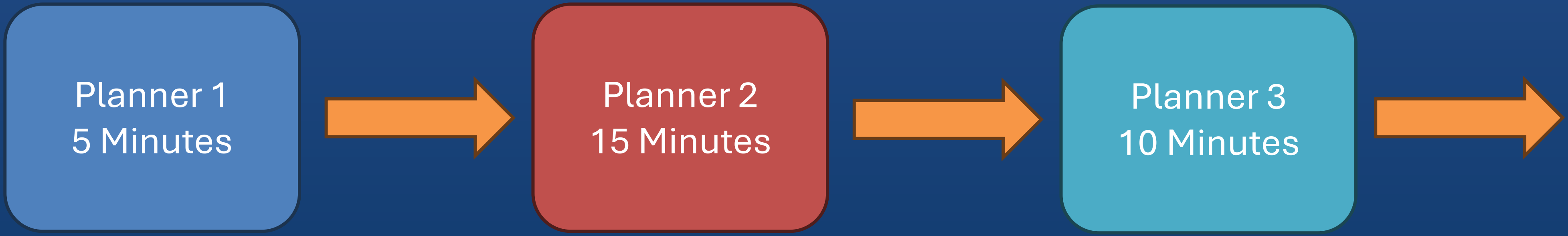
Michael Hentz

Observations

- After Fast Downward, two things made clear:
    - No current single algorithm or heuristic dominates all others
        - Different Heuristics work better on different problems
    - If a planner does not solve quickly, problem will probably not be solved
        - In the competition, each problem is 30 to 60 minutes
- Can we take the best of each?

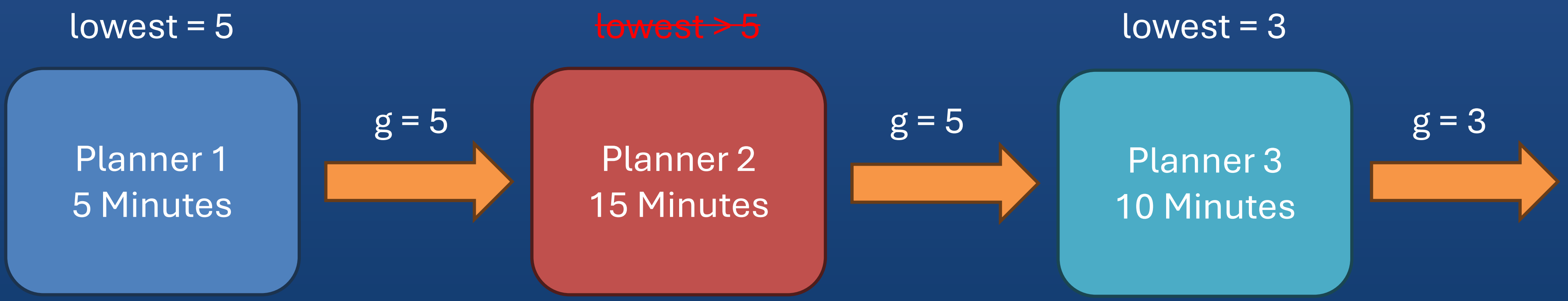
Sequential Planning Portfolios

- List of different planners in specific order
  - Different Planners and Different Heuristics
- Run each planner at a time with given slice of overall time
- Fast Downward Stone Soup
  - Naming: The Folk Tale of the Stone Soup
  - Sum of planners beats each individual planner



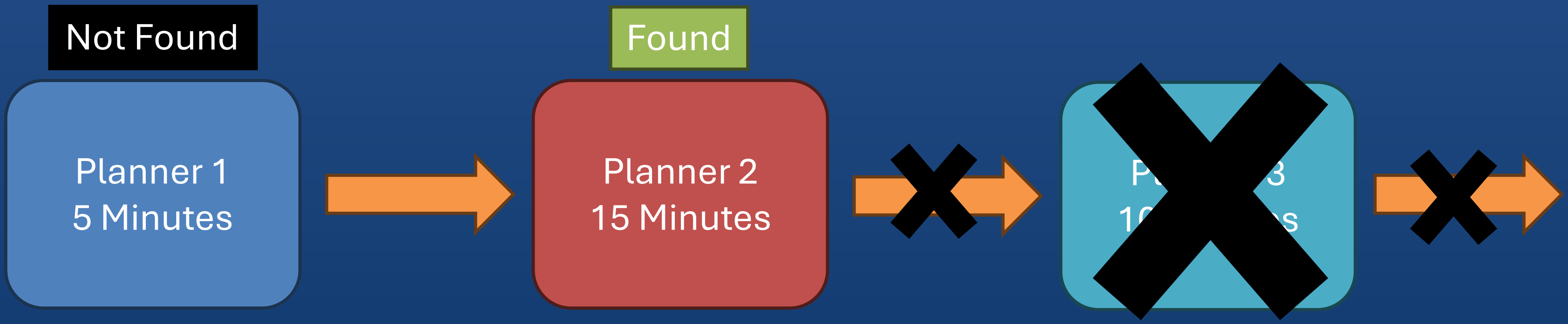
Optimal Portfolio Planner

- Find the best solution
  - Lowest Cost and Shortest Plan
- Planners communicate the current best in the sequence
  - Next planners can prune plans currently larger than the current best



Satisficing Portfolio Planner

- Find any solution
- Portfolio ends once any planner finds solution



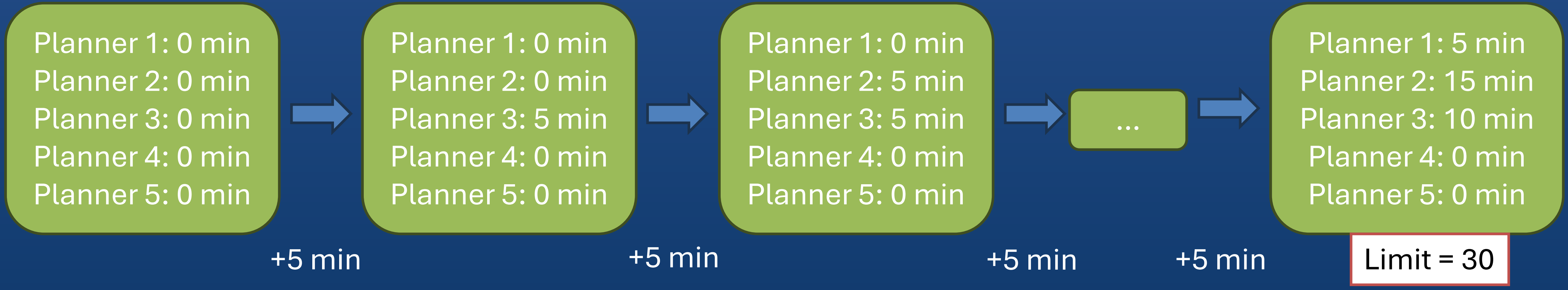
Describing Planner Portfolio

- Set of planners in portfolio is subset of possible planners in portfolio
- Portfolio represented as map of algorithms to allotted time
  - Time of 0 means algorithm not in portfolio
- Want to get “Holy Grail” – Each problem can be solved by at least one algorithm in portfolio

Planner 1: 5 min
Planner 2: 15 min
Planner 3: 10 min
Planner 4: 0 min
Planner 5: 0 min
…

Building Planner Portfolio

- Use Hill Climbing algorithm to find best portfolio
  - Start with portfolio of all algorithms set to 0
  - Successor portfolios are same as current but with allotted time added to one algorithm
  - Best successor chosen as new current portfolio
  - Repeat until sum of allotted time is more than overall time limit



Planner 1: 0 min
Planner 2: 0 min
Planner 3: 0 min
Planner 4: 0 min
Planner 5: 0 min

+5 min

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…

+5 min

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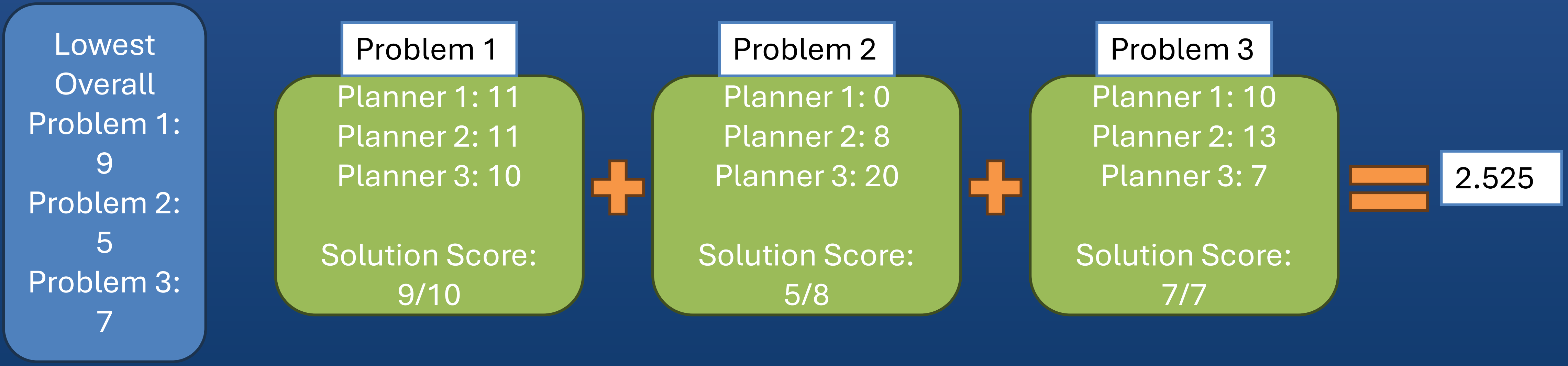
Limit = 30

Judging Planner Portfolio

- Portfolios can be judged based on how well they solve test problems
- Sum of all solution costs of all test problems for portfolio
  - Solution cost of a test problem for a portfolio is the lowest cost of any possible algorithm solving divided by lowest cost of portfolio solving



Lowest Overall
Problem 1: 9
Problem 2: 5
Problem 3: 7

Problem 1
Planner 1: 11
Planner 2: 11
Planner 3: 10

Solution Score: 9/10

+

Problem 2
Planner 1: 0
Planner 2: 8
Planner 3: 20

Solution Score: 5/8

+

Problem 3
Planner 1: 10
Planner 2: 13
Planner 3: 7

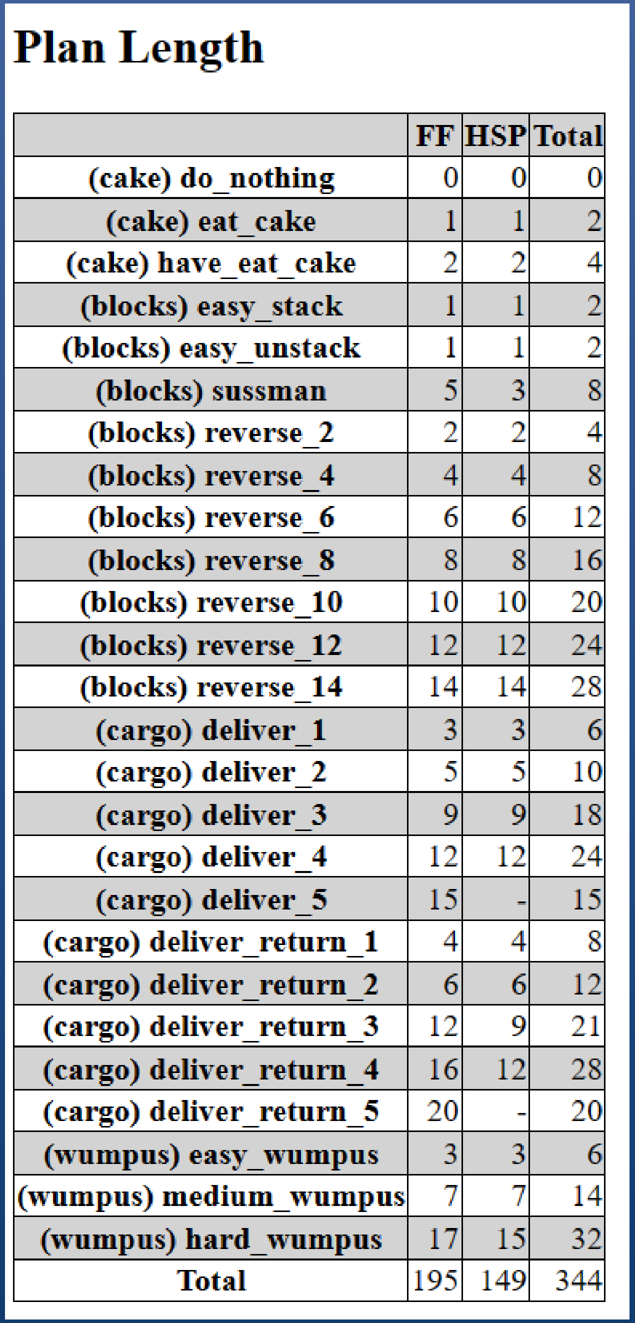
Solution Score: 7/7

=

2.525

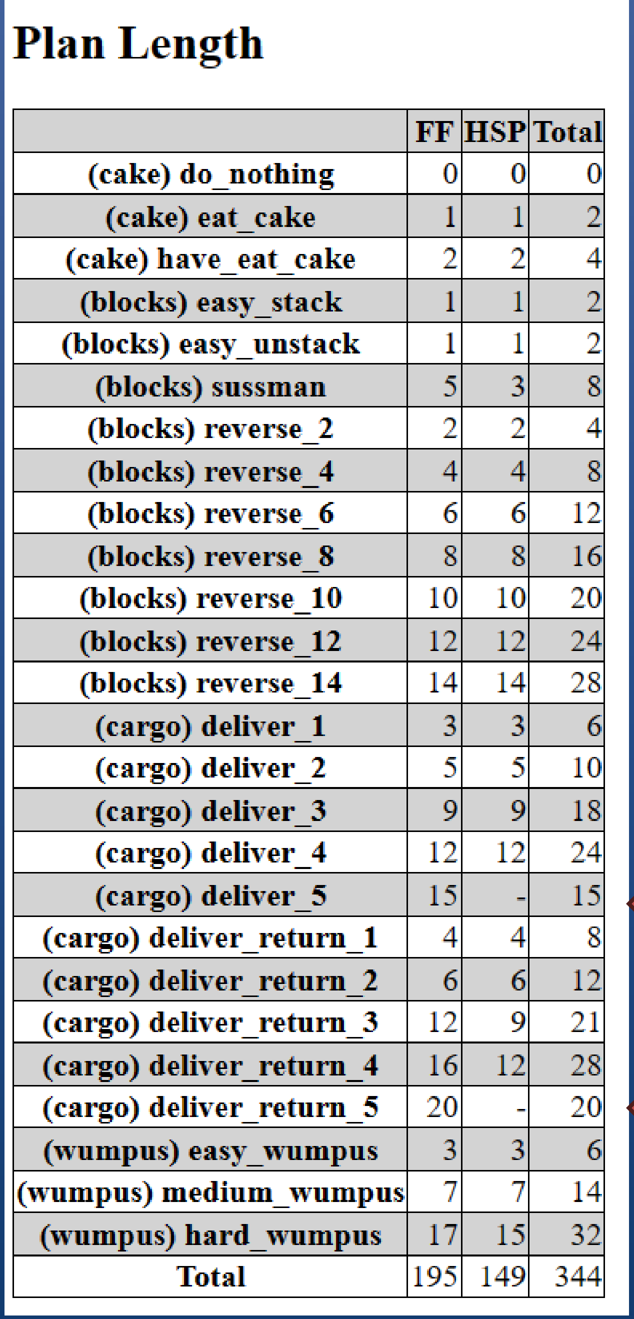
Demonstration

Optimal Track comparing HSP, Fast Forward, and Planner Portfolio of HSP and Fast Forward



Plan Length

	FF	HSP	Total
(cake) do_nothing	0	0	0
(cake) eat_cake	1	1	2
(cake) have_eat_cake	2	2	4
(blocks) easy_stack	1	1	2
(blocks) easy_unstack	1	1	2
(blocks) sussman	5	3	8
(blocks) reverse_2	2	2	4
(blocks) reverse_4	4	4	8
(blocks) reverse_6	6	6	12
(blocks) reverse_8	8	8	16
(blocks) reverse_10	10	10	20
(blocks) reverse_12	12	12	24
(blocks) reverse_14	14	14	28
(cargo) deliver_1	3	3	6
(cargo) deliver_2	5	5	10
(cargo) deliver_3	9	9	18
(cargo) deliver_4	12	12	24
(cargo) deliver_5	15	-	15
(cargo) deliver_return_1	4	4	8
(cargo) deliver_return_2	6	6	12
(cargo) deliver_return_3	12	9	21
(cargo) deliver_return_4	16	12	28
(cargo) deliver_return_5	20	-	20
(wumpus) easy_wumpus	3	3	6
(wumpus) medium_wumpus	7	7	14
(wumpus) hard_wumpus	17	15	32
Total	195	149	344



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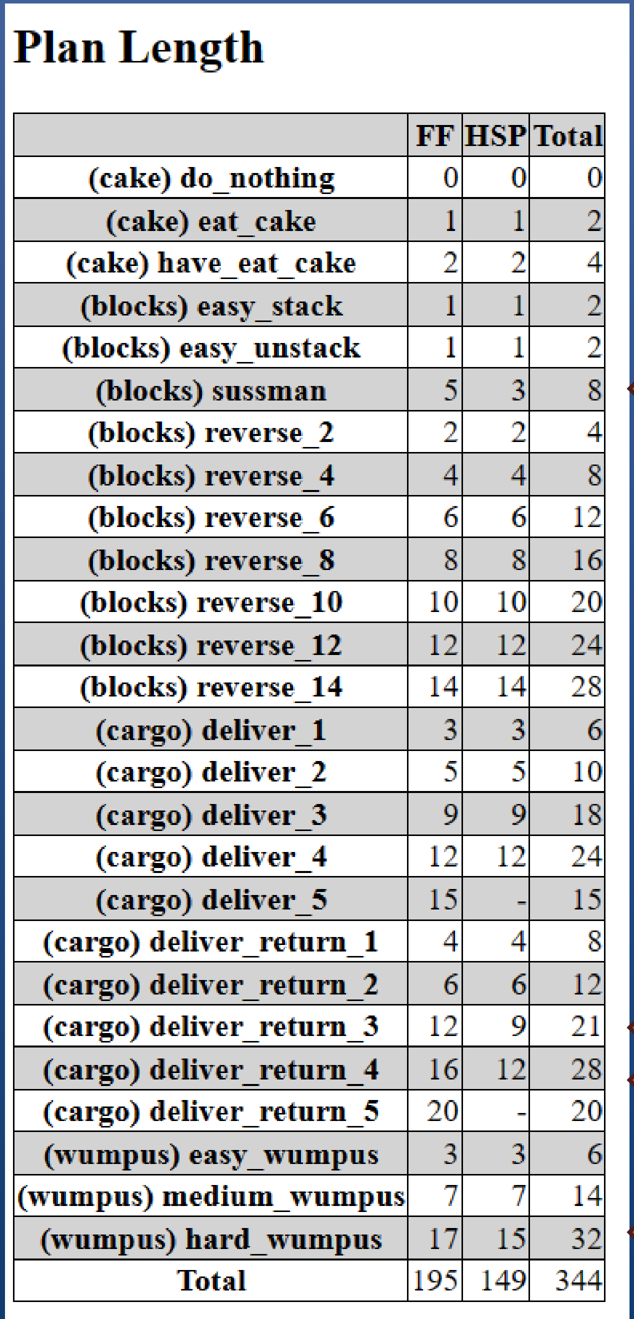
HSP

Solves

24



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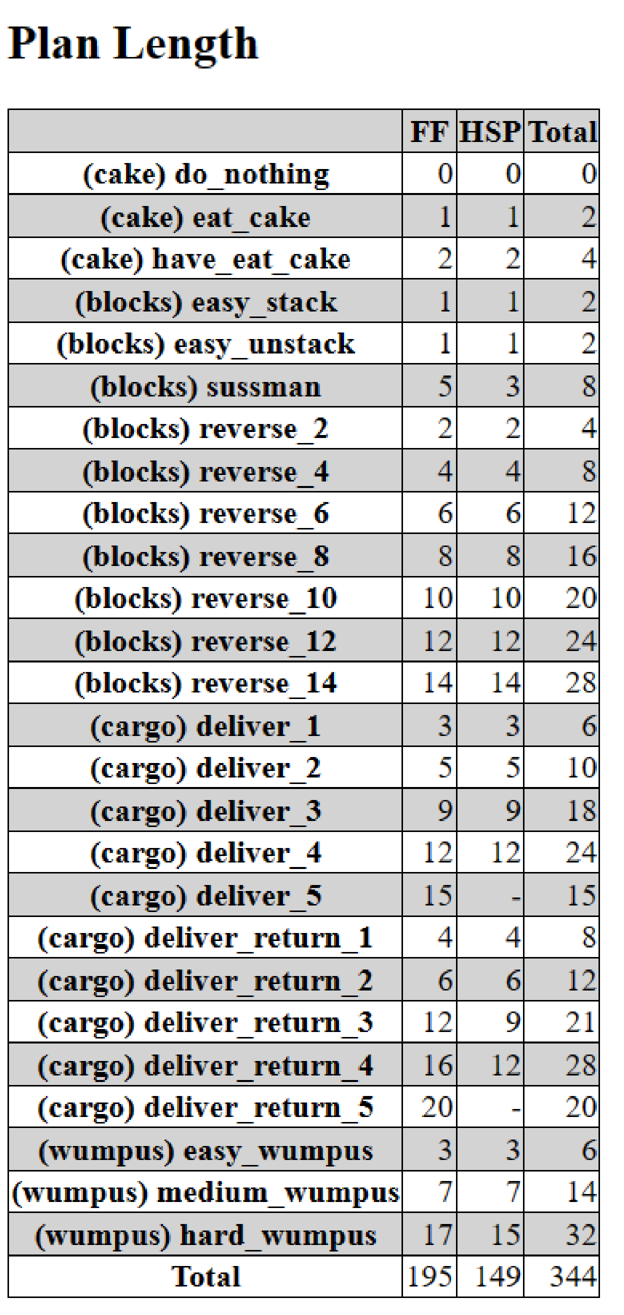
Solves

20



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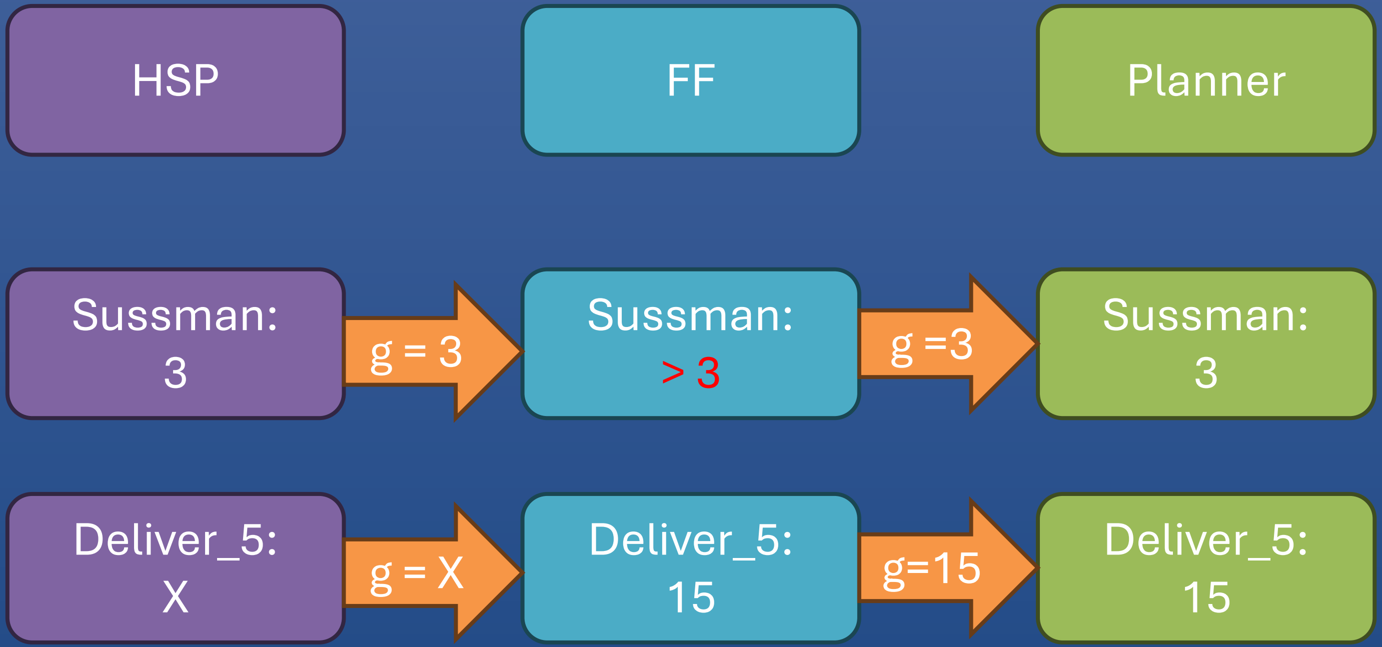


HSP

FF

Planner

Sussman: 3

g = 3

Sussman: > 3

g =3

Sussman: 3

Deliver_5: X

g = X

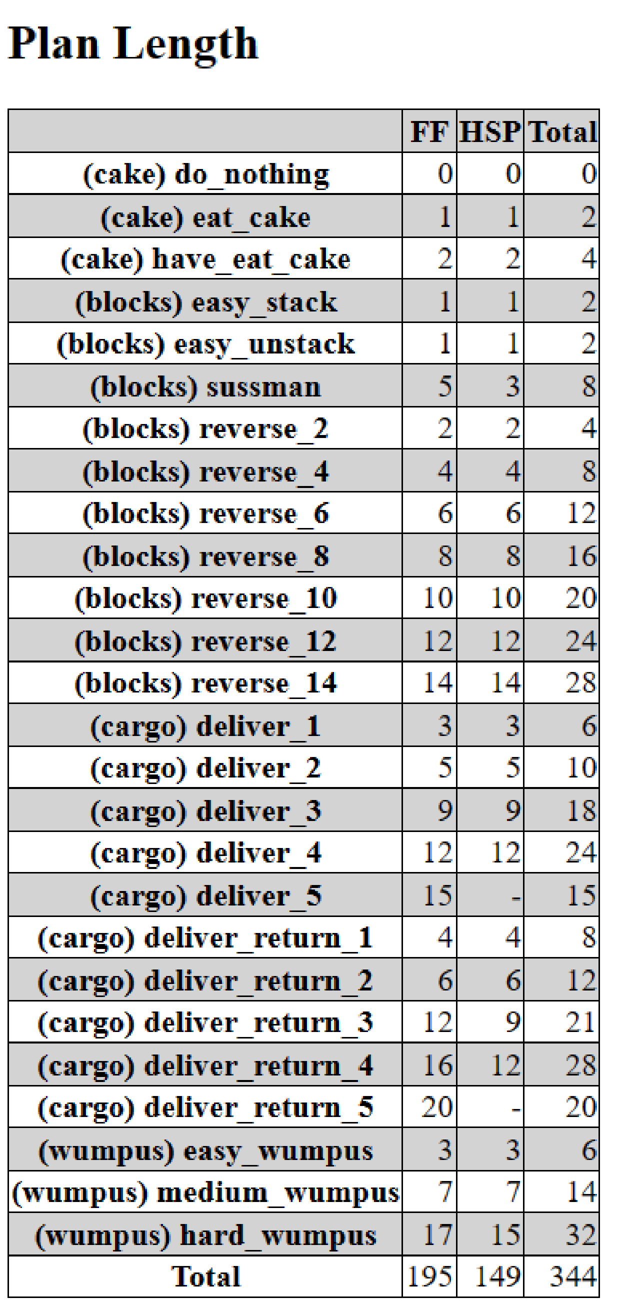
Deliver_5: 15

g=15

Deliver_5: 15

Planner Portfolio of HSP and Fast Forward solves all 26

(During planning, Fast Forward of Sussman would be pruned of all plans that exceed g)



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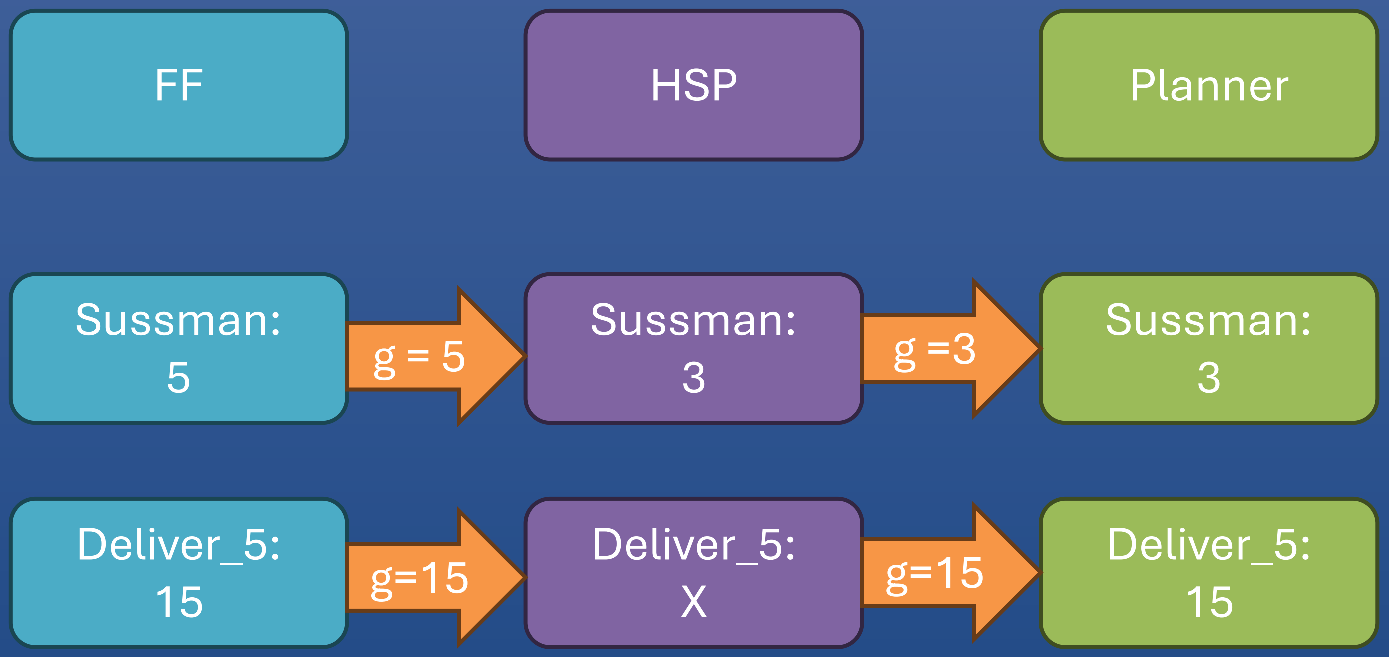

Planner Portfolio of Fast Forward and HSP solves all 26

Optimizing Planner Portfolio

- With Fast Downward, data transferring from planner to planner takes time away from allotted time of each planner
- Possible excess time utilization
- Ordering of planners in portfolio
- Need test problems
- Possibly more transfer of data

Sequential Planning Portfolios

- After Fast Downward:
  - No current single algorithm or heuristic dominates all others
  - If a planner does not solve quickly, problem will probably not be solved
- List each algorithm with a slice of the limited time and run each planner sequentially with given slice of overall time
- The sum of the algorithms beats each individual algorithm
- Satisficing and Optimizing
- Much more optimizing is possible