


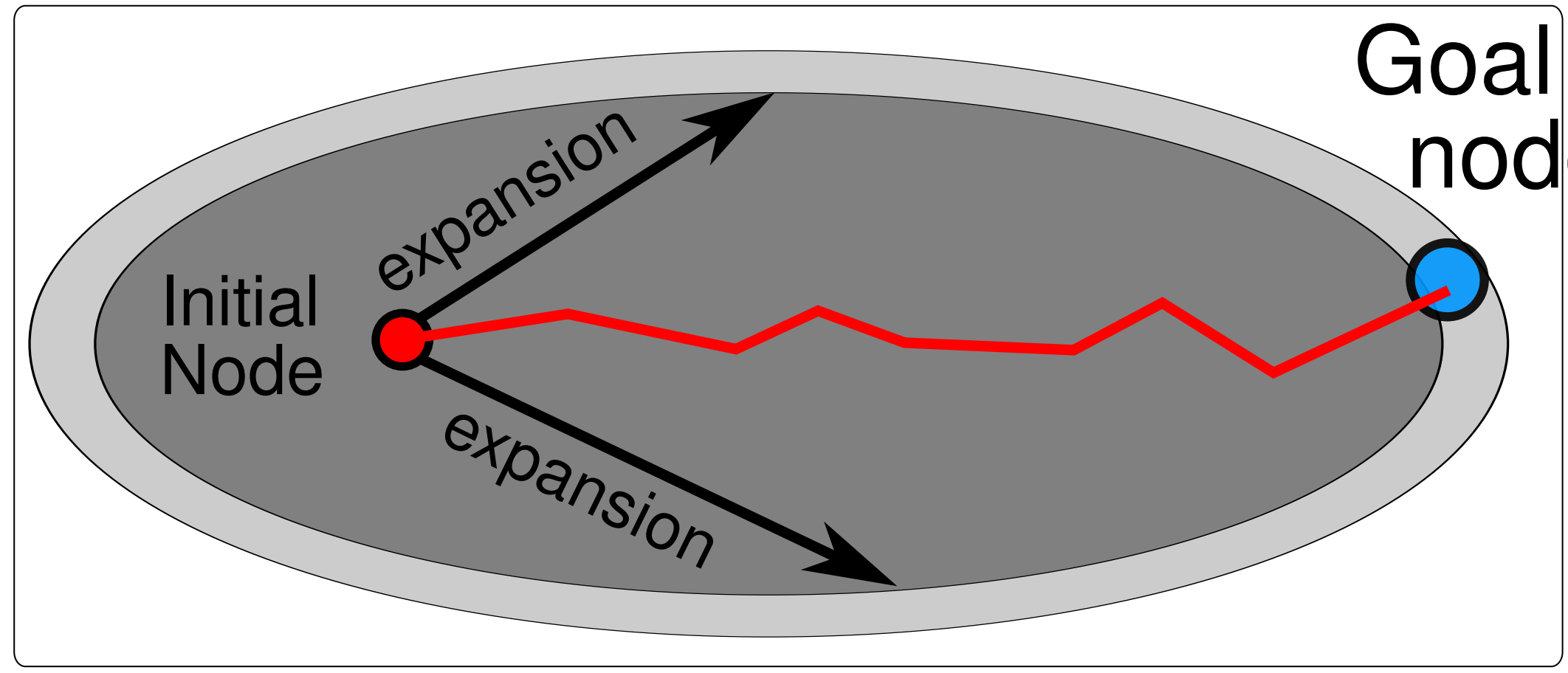


How to Explore the Final Frontier

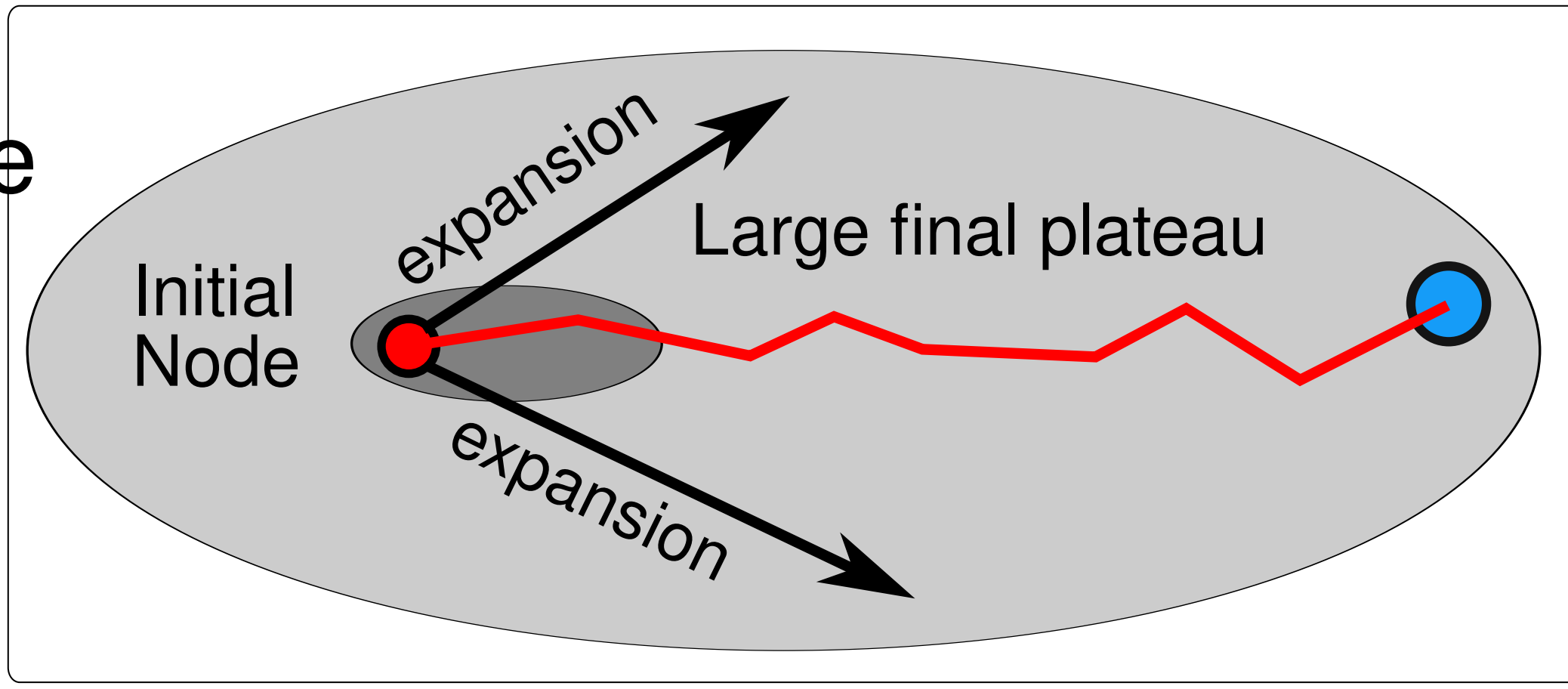
Masataro Asai and Alex Fukunaga, Graduate School of Arts and Sciences, The University of Tokyo

1. Search Space wrto f value: **Tiebreaking Quite Important**

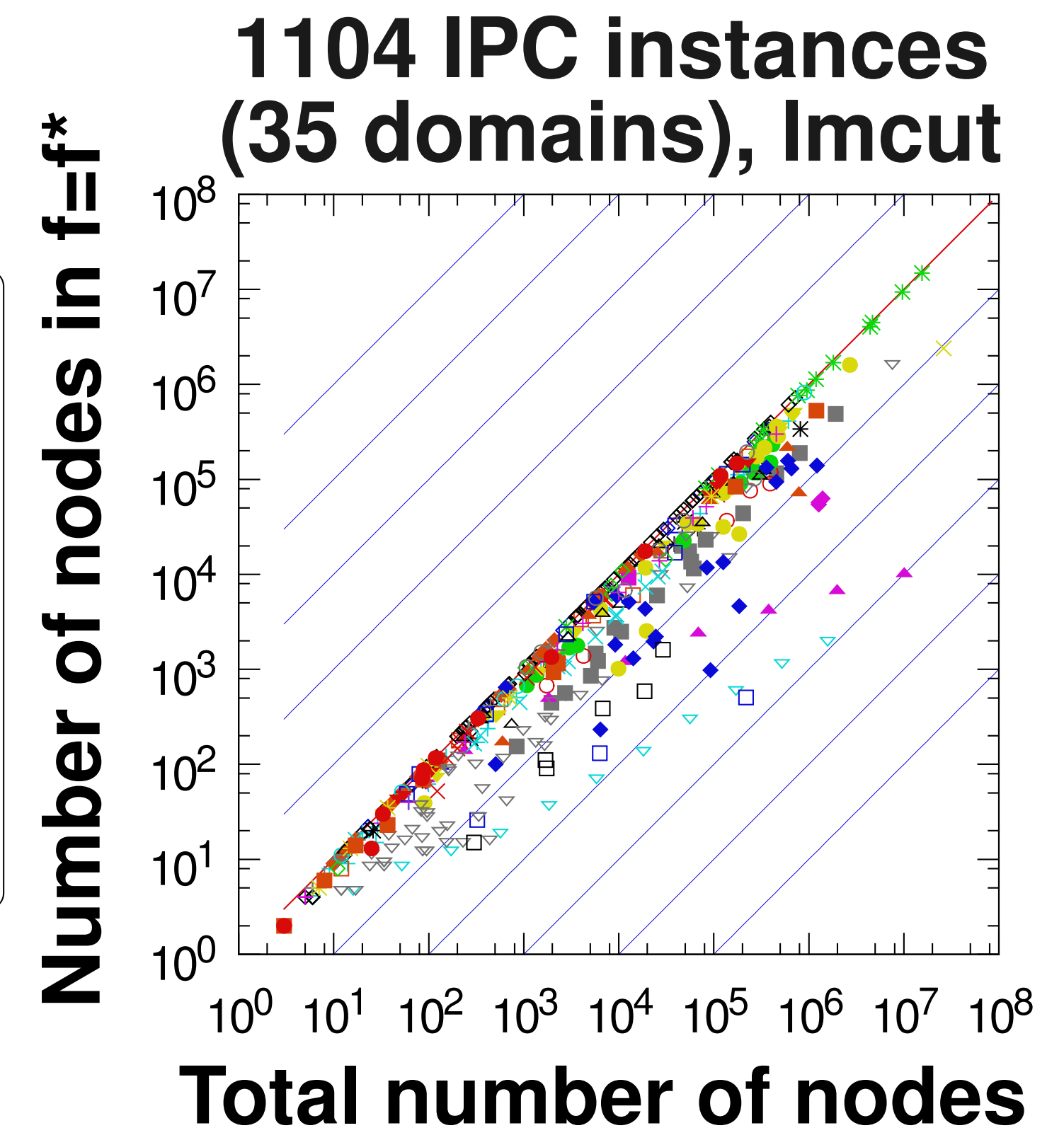
-  $f > f^*$ (entire search space, A^* never expands outside ellipse)
-  $f = f^*$ (some nodes are expanded by A^*)
-  $f < f^*$ (all nodes are expanded by A^*)



Grid Pathfinding etc.
Small $f=f^*$ plateau
→ Tiebreaking unimportant



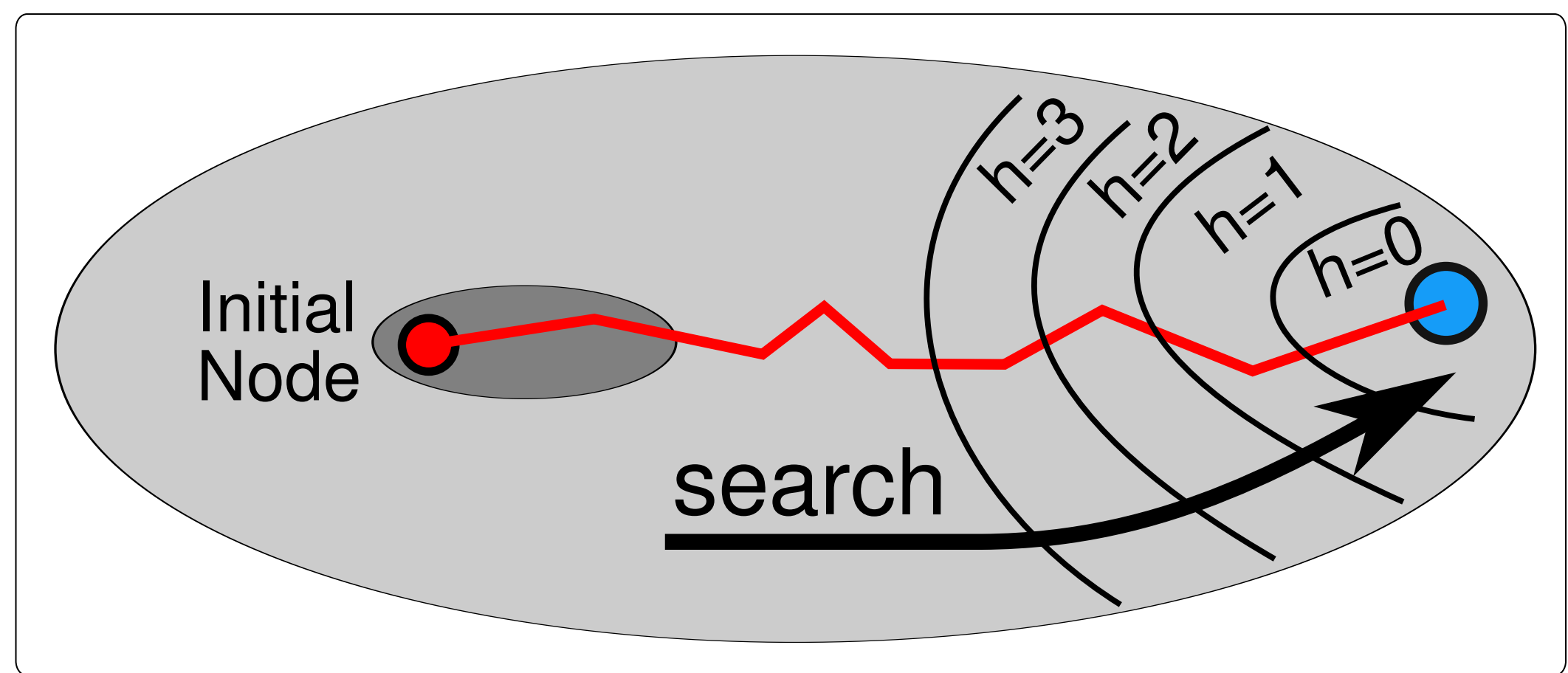
Planning Problems:
Almost ALL nodes in $f=f^*$ plateau
→ Tiebreaking quite important



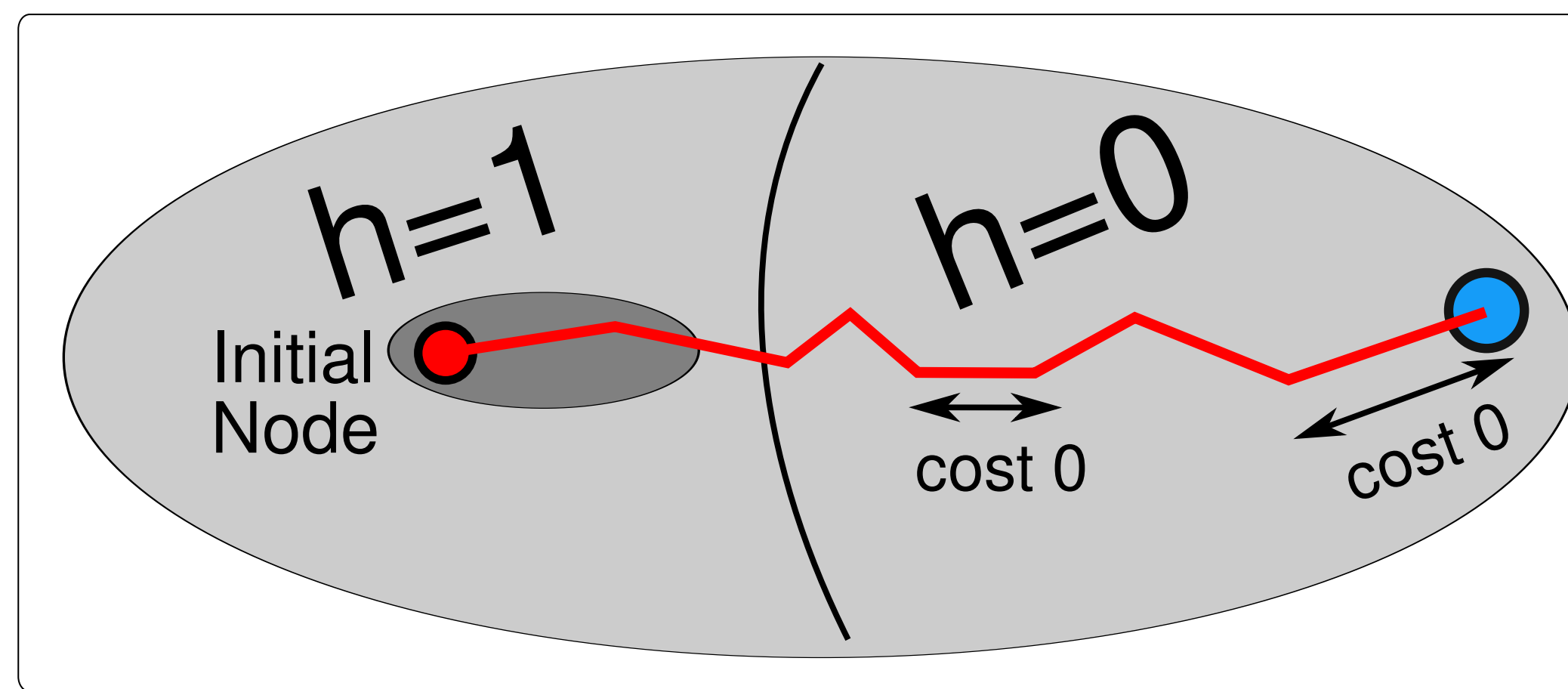
2. h tiebreaking (std. method) can fail with 0-cost edges

Domains with Positive Action Costs only

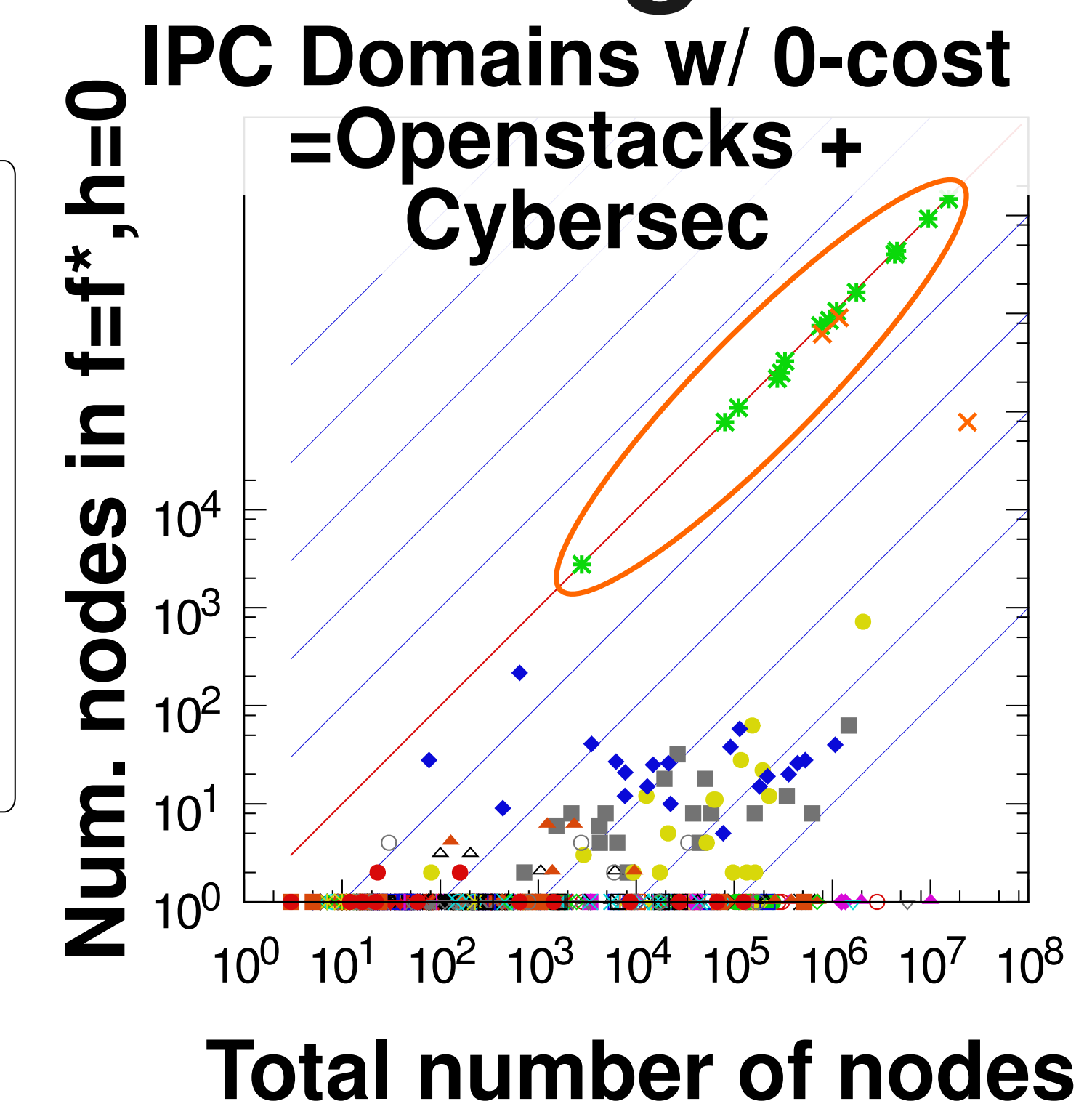
Domains with 0-cost Actions



h-based tiebreaking gives heuristic guidance

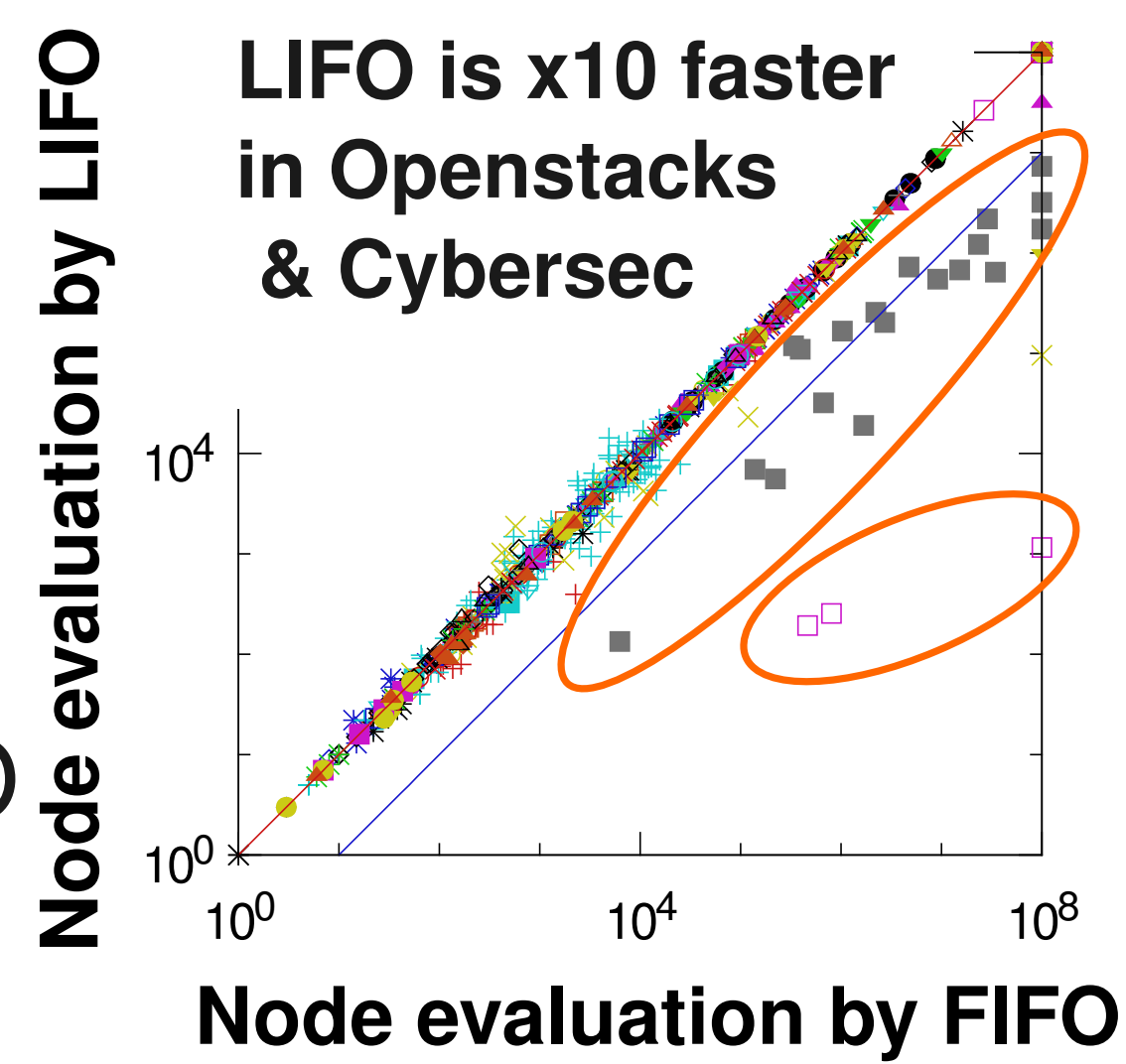


Almost ALL nodes in $h=0$
h-tiebreaking does not work



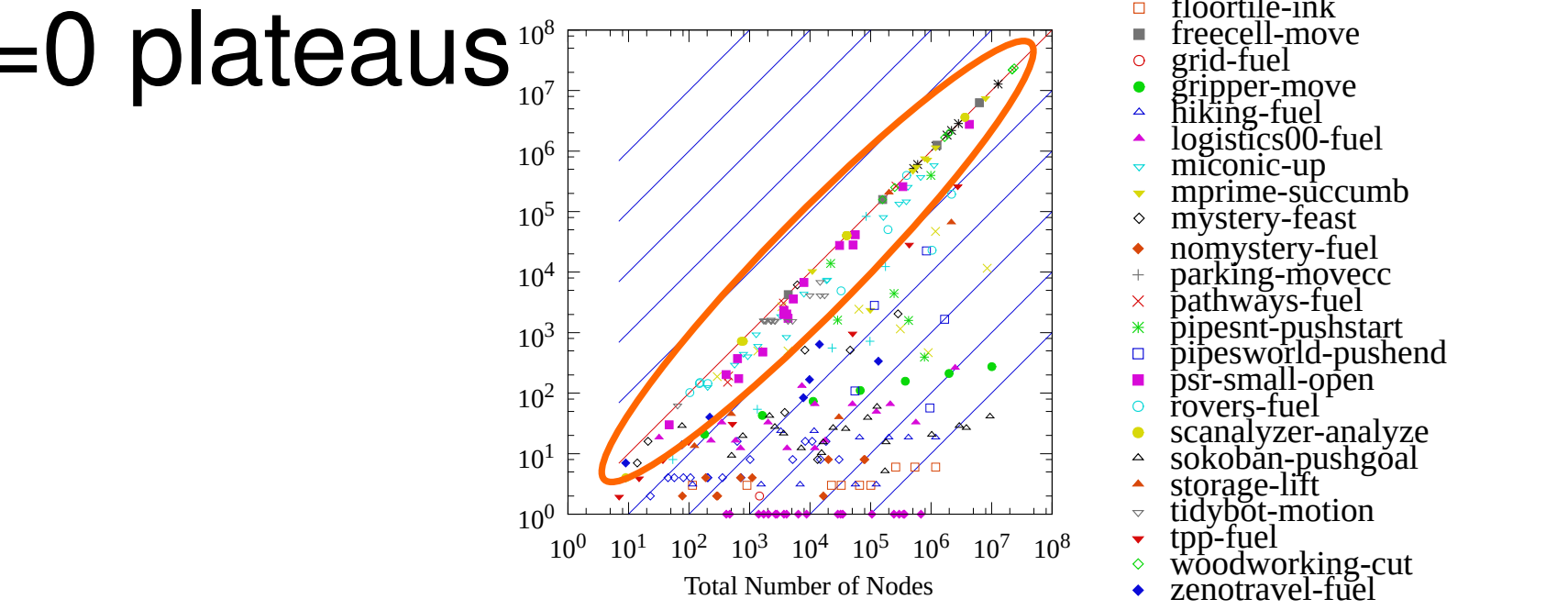
3. h-tiebreaking is underspecified: LIFO/FIFO makes difference with Zero-cost actions

- Many nodes with same f value **and** h value
- A* must select **exactly one** node
- Many solvers use either LIFO/FIFO
- Many papers do not mention this detail
- Huge performance difference by LIFO/FIFO in domains with zero-cost actions



4. Unit-cost IPC (num. step)
→ Zerocost (resource usage)

- More realistic resource optimization domains
 - Resource-consuming actions: positive cost
 - 0-cost otherwise
 - e.g. Driverlog: minimize fuel
(drive-truck: cost>0, other actions: cost=0)
 - 620 new instances (28 domains)
 - Larger h=0 plateaus overall
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5. Improve upon LIFO: RandomDepth

- Divide Final Plateau ($f=f^*, h=0$) into layers
- LIFO = Depth-first = select largest depth
- FIFO = Breadth-first = select smallest depth
- Bias \rightarrow pathological behavior \therefore Diversify it
- Selecting the depth at random: RandomDepth

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