ICAPS-22, Jun. 21st – 24th, 2021

Solving Simultaneous Target Assignment and Path Planning Efficiently with Time-Independent Execution

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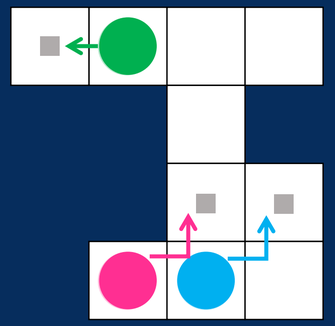
Summary

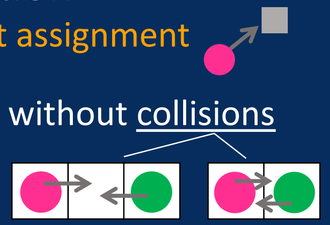
- ✓ complete, sub-optimal, quick, and scalable algorithm (TSWAP) for unlabeled multi-agent pathfinding (MAPF)
- ✓ applicable to both offline & online scenarios, i.e., async execution



Problem Definition: Unlabeled-MAPF

given
- graph
- agents (starts)
- targets

solution
target assignment
&
paths without collisions



Motivation

	optimal	sub-optimal
MAPF	CBS, M*, BCP, ... [Sharon+ AIJ-15, Wagner+ AIJ-15, Lam+ COR-22]	MAPP, PIBT, EECBS, ... [Wang+ JAIR-11, Okumura+ IJCAI-19, Li+ AAAI-21]
unlabeled-MAPF	reduction to maximum flow [Yu&LaValle WAFR-13]	

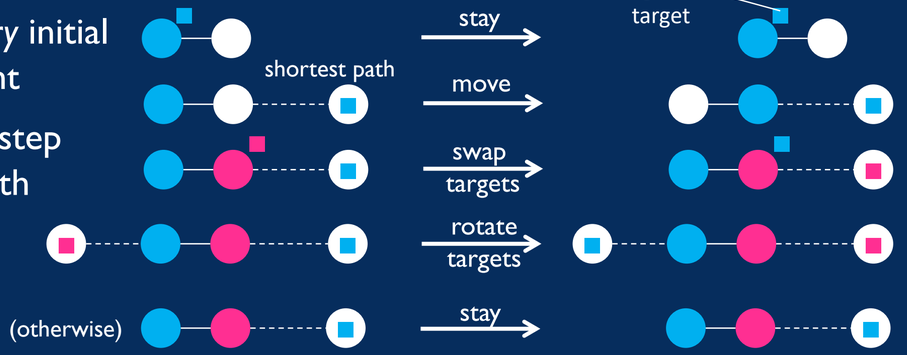
objective:
solve large unlabeled-MAPF
with *sufficiently good quality*
in *small computation time*

code & movie:
https://kei18.github.io/tswap

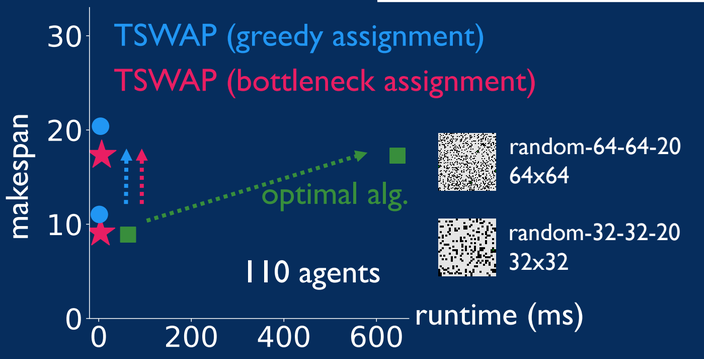
TSWAP Algorithm

Step 1. compute *arbitrary* initial target assignment

Step 2. repeat one-timestep path planning with target swapping



Evaluation & Robot Demo



2000 agents	runtime (sec): optimal algorithm [Yu&LaValle WAFR-13]	runtime (sec): TSWAP	sub-optimality (makespan)
lak303d (194x194)	56.3	0.4	1.36
den520d (257x256)	89.8	0.4	1.17
brc202d (418x530)	230.2	1.1	1.02

✓ adaptive to timing uncertainties