MULTI-AGENT PATH FINDING

Simulation of manufacturing processes combining centralized and decentralized approaches

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Problem

- In modern manufacturing products are highly customized. To reach this high level of customization the products should find their own paths to the operations within the shop floor.

Problem model

- Each robot represents a customized product that should be processed by specific operations.

- The shop floor is mapped as a grid in which operations are colored nodes. These nodes also differ from regular nodes on the time/steps taken to cross them.

Grid Map
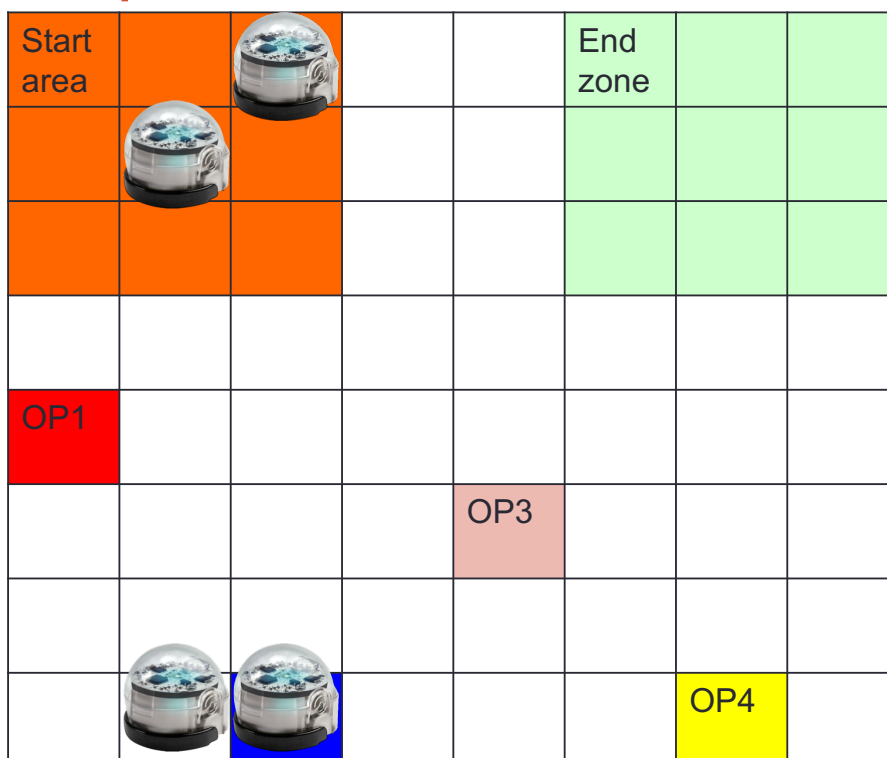
Proposed approach

- Centralized approach:
  - At beginning each robot is going to be initialized with the operations it should go to, e.g. Operations that need to be in specific order, other operations that can be visited in any order, etc.
  - Centralized planner will calculate the path for all robots, considering each operation that is occupied as nodes that have weighted step number. For example, each regular node count as 1 step on path, but a node representing an operation counts as many steps as the time it's occupied by some robot. That means, if an operation take 60 steps to finish and there is a robot being processed there, the node counts as how many steps are still remaining. The steps are decremented in counter.

Proposed approach

- Decentralized approach:
  - If for some reason the original plan doesn't work, resulting in a collision between robots, the robot stop and wait for specified time and try to keep following the initial plan. If collision remains, it become an independent decentralized agent calculating his own paths.
  - This might occur due to any external influence: low battery might make robot move slower than expected; too grip or slippery ground may affect the speed or direction of a robot, etc.