

MANU2480

AUTONOMOUS SYSTEM

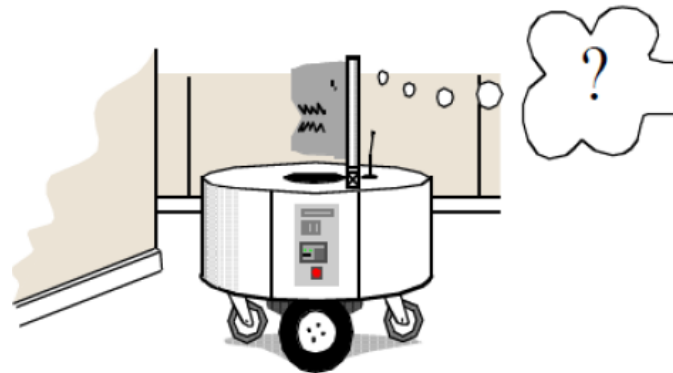
Mapping – Part 1

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Problem Statement

The three key questions to be answered for a mobile robot to exhibit an autonomous behaviour:

- Where am I ?
- Where am I going ?
- How do I get there ?



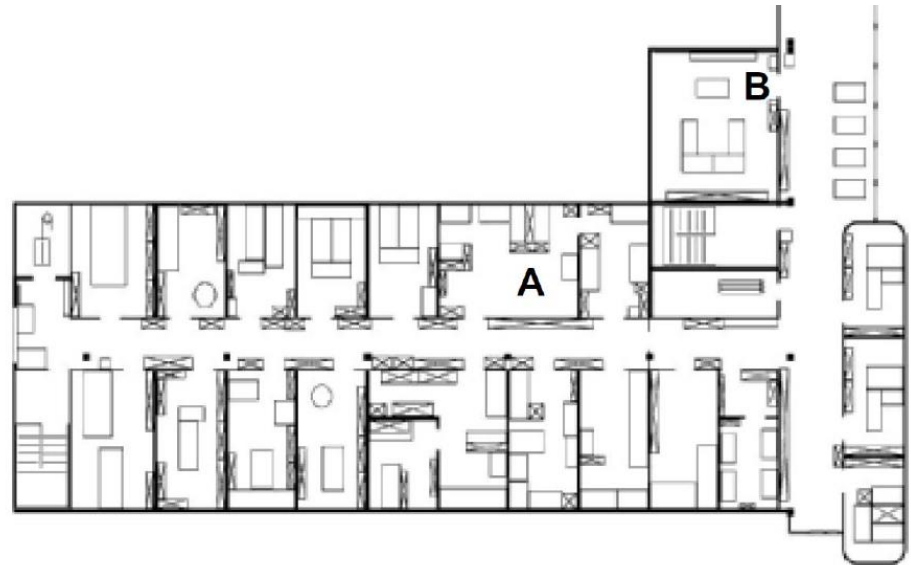
Approach

To answer these questions, the robot needs to:

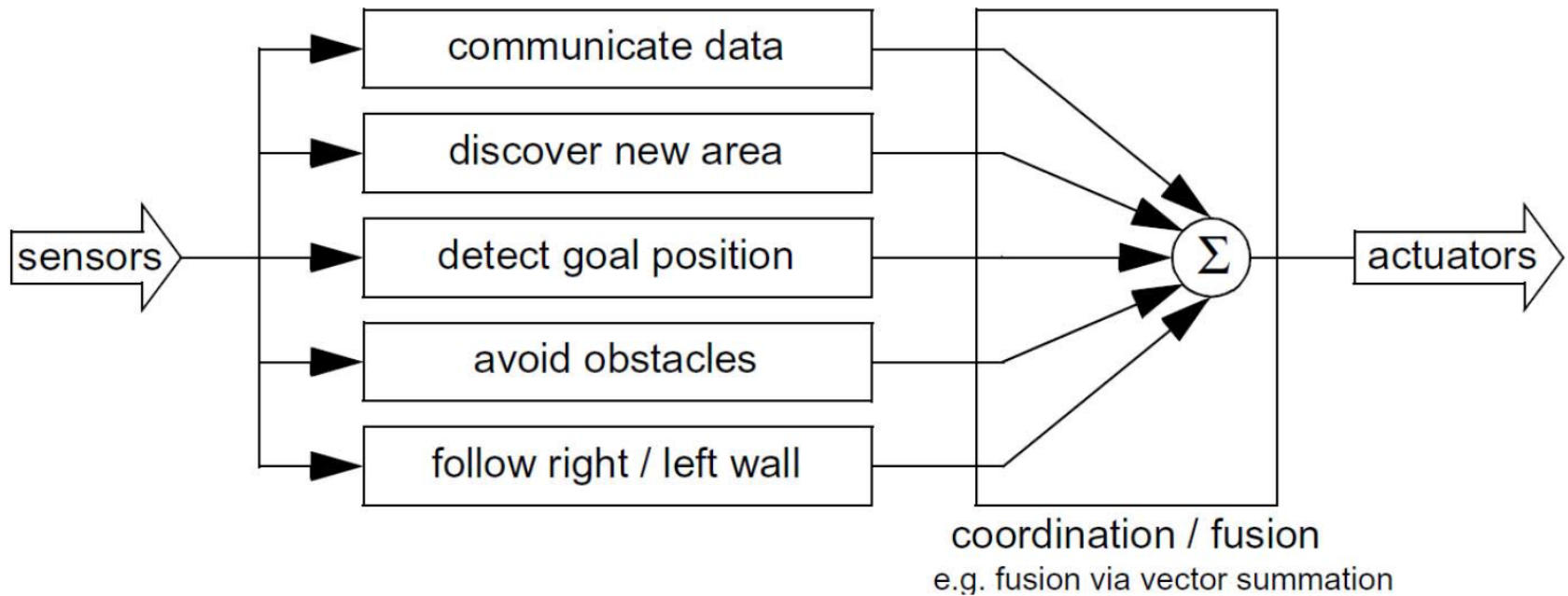
- Have a model of the environment, given or autonomously built (**mapping**);
- Plan path or trajectory (**path planning**).

Sample

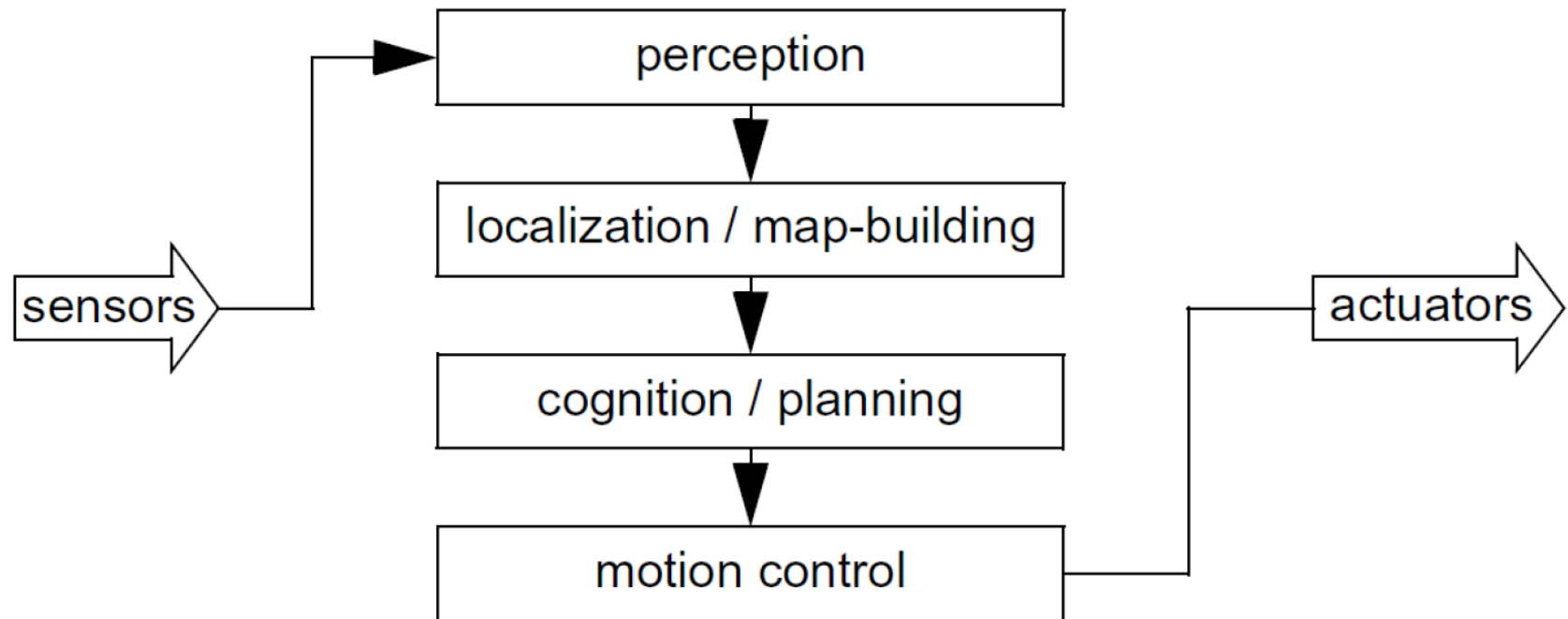
Autonomous navigation and path planning of a robotic nurse from room to room in a hospital ward. For instance, move from a current position A to the next point B.



Behaviour-Based Navigation



Map-Based Navigation



Map Representation

➤ Continuous representations:

continuous modelling of environmental obstacles using simple geometrical shapes.

- Using line segments
- Using polygons

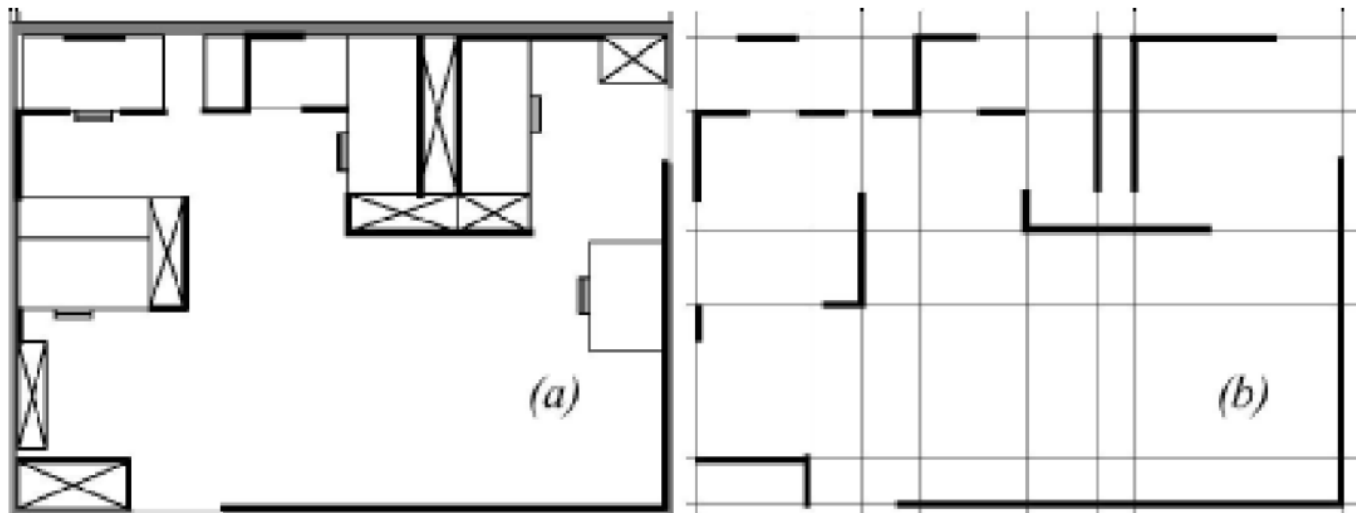
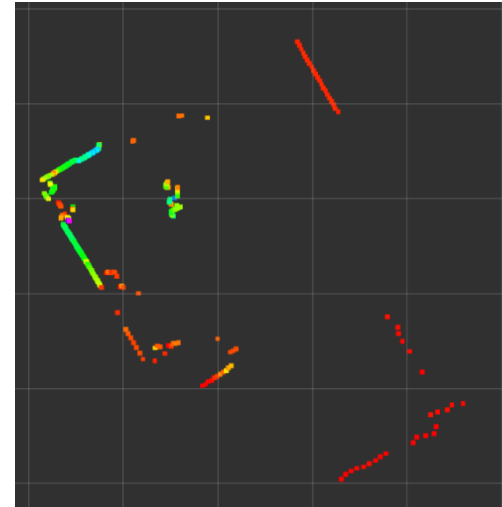
➤ Grids

- exact cell decomposition
- fixed cell decomposition
- adaptive cell decomposition

➤ Topological representations

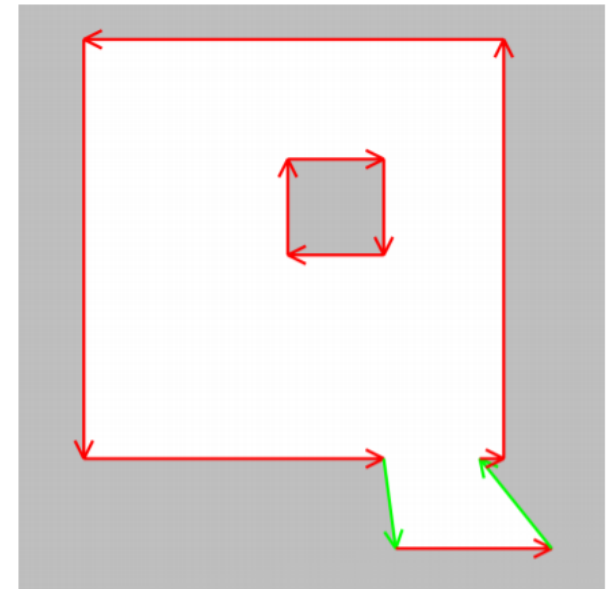
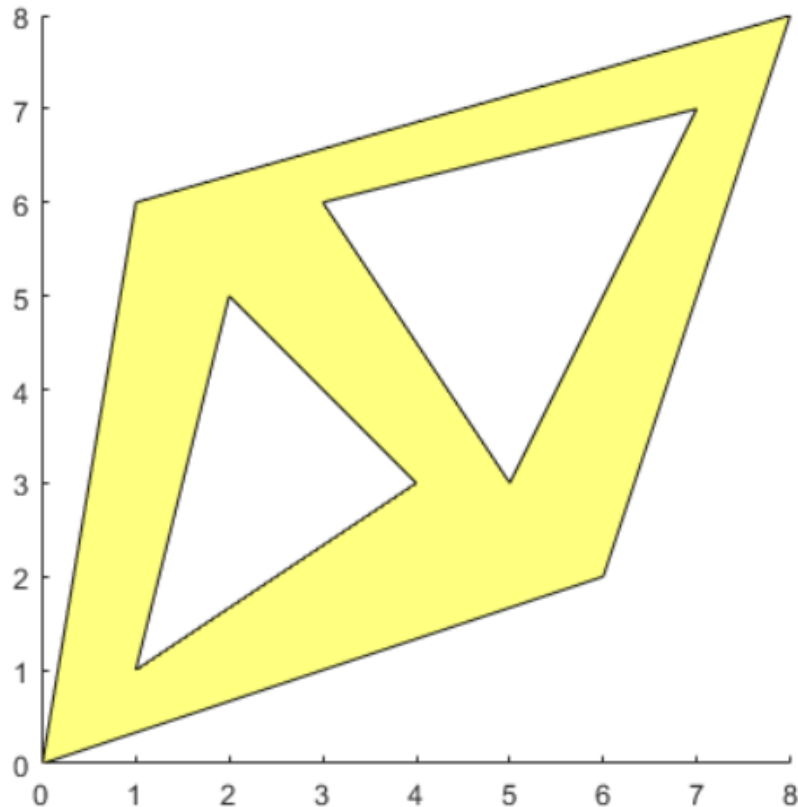
Continuous Representation: Line Segments

Basic spatial elements include points, lines and polygons.



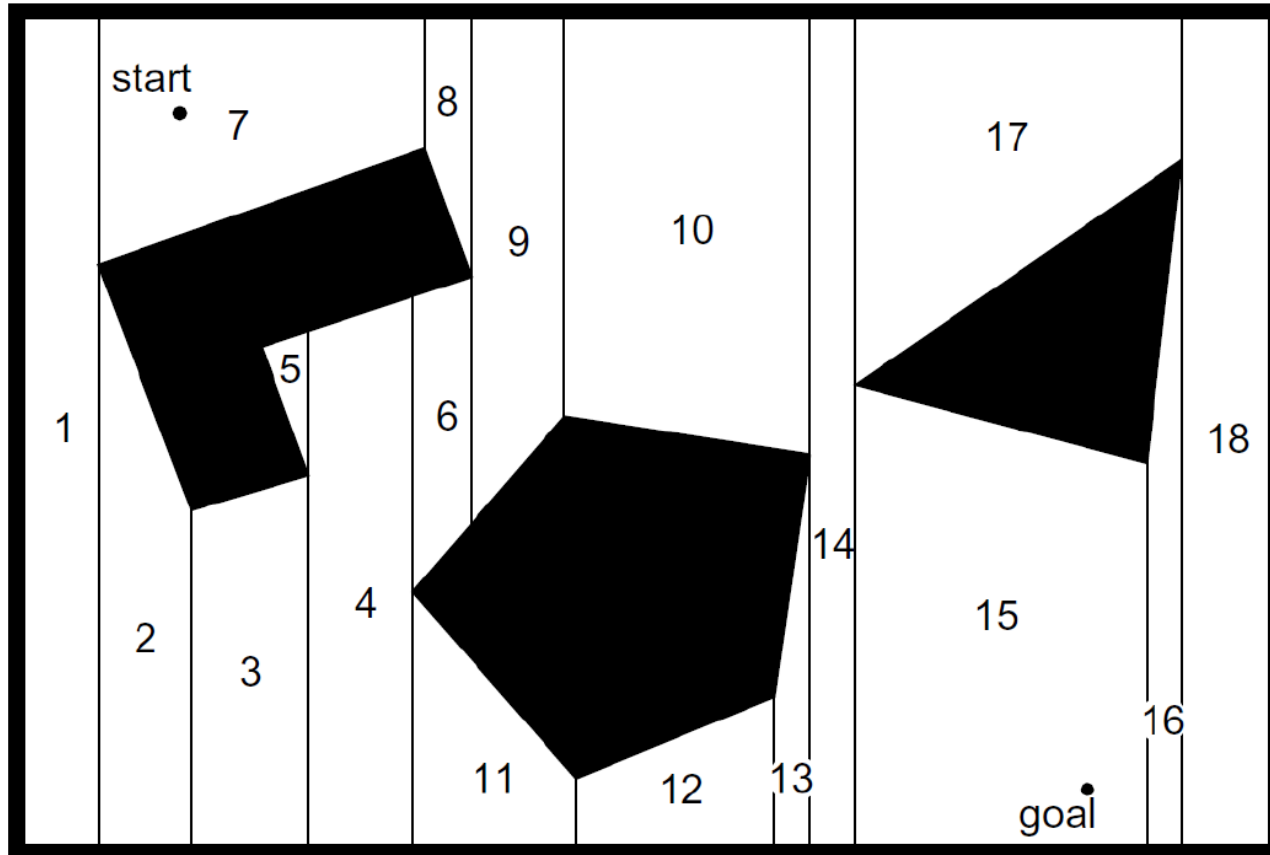
Reference: <https://www.mathworks.com/help/map/ref/polyxpoly.html>

Continuous Representation: Polygons

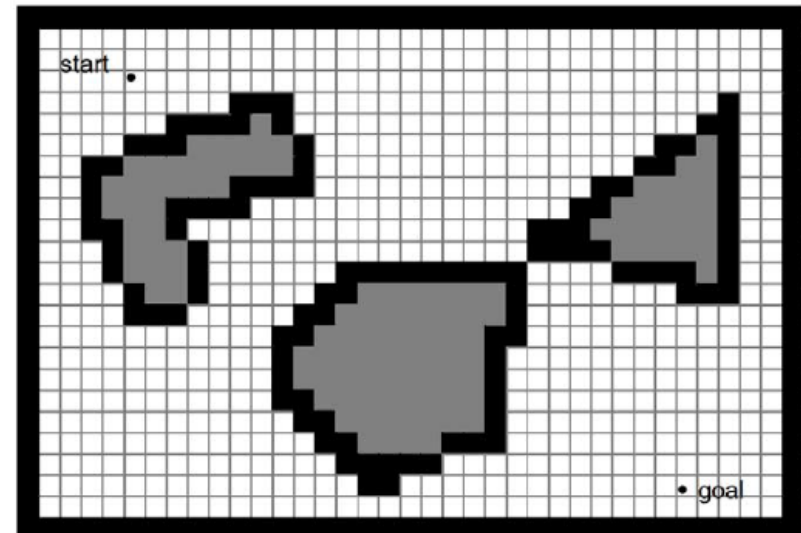
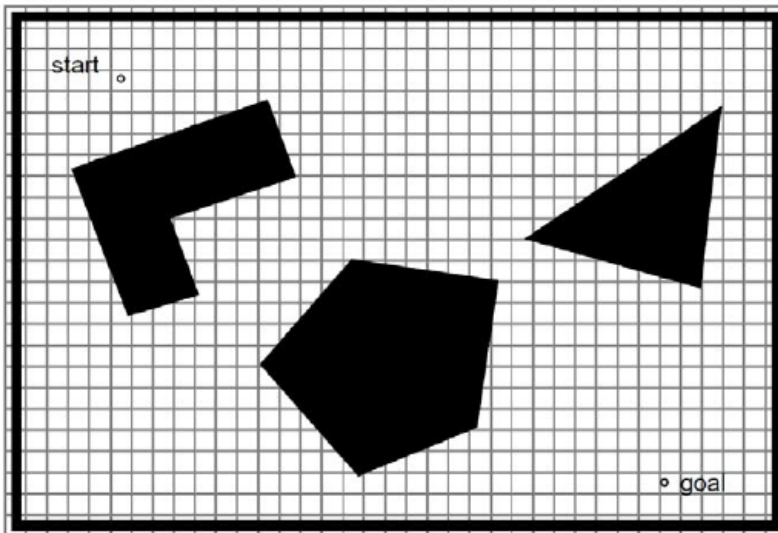


Reference: <https://www.mathworks.com/help/map/create-and-display-polygons.html>

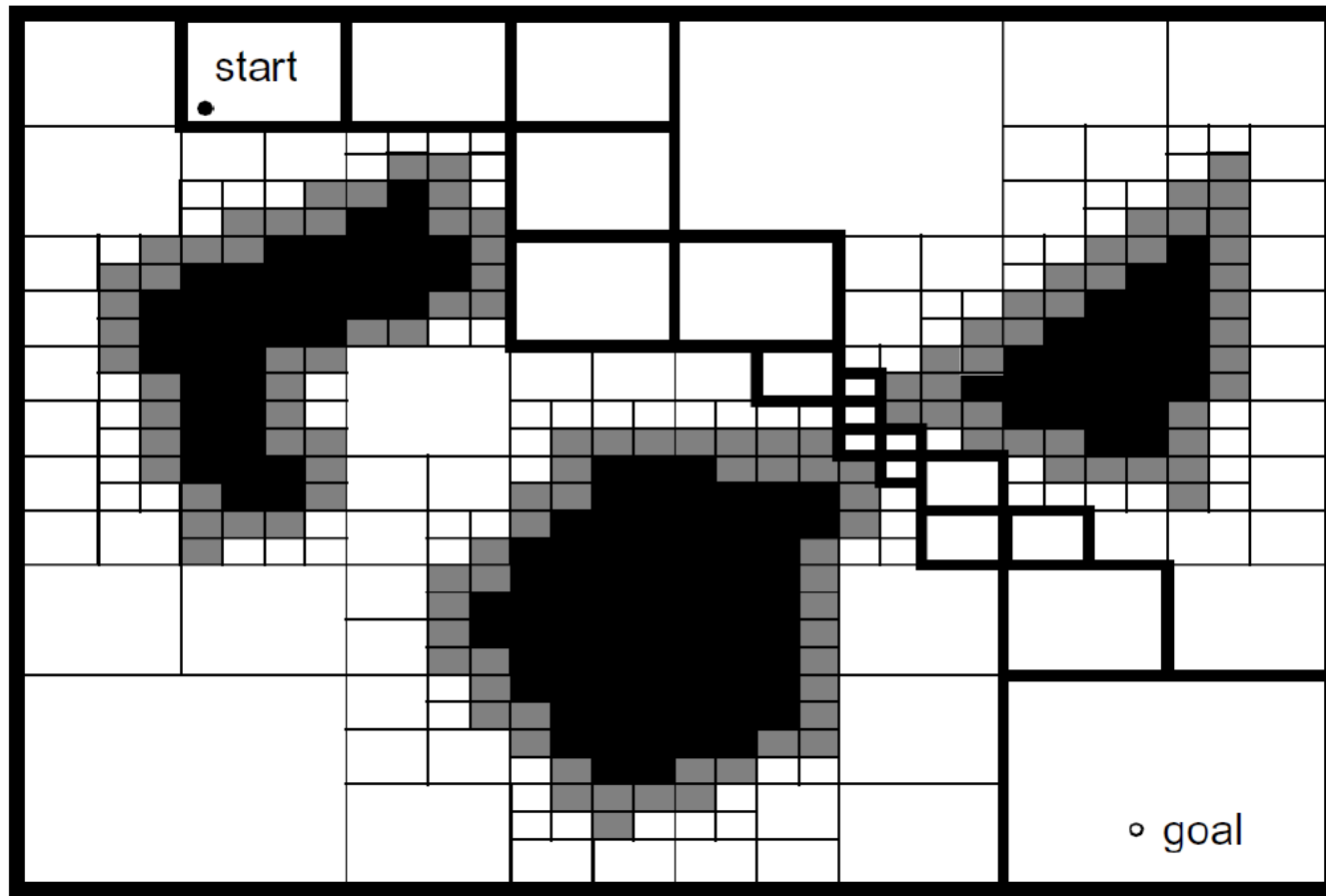
Grid: Exact Cell Decomposition



Grid: Fixed Decomposition



Grid: Adaptive Decomposition – Approximate Variable Cell



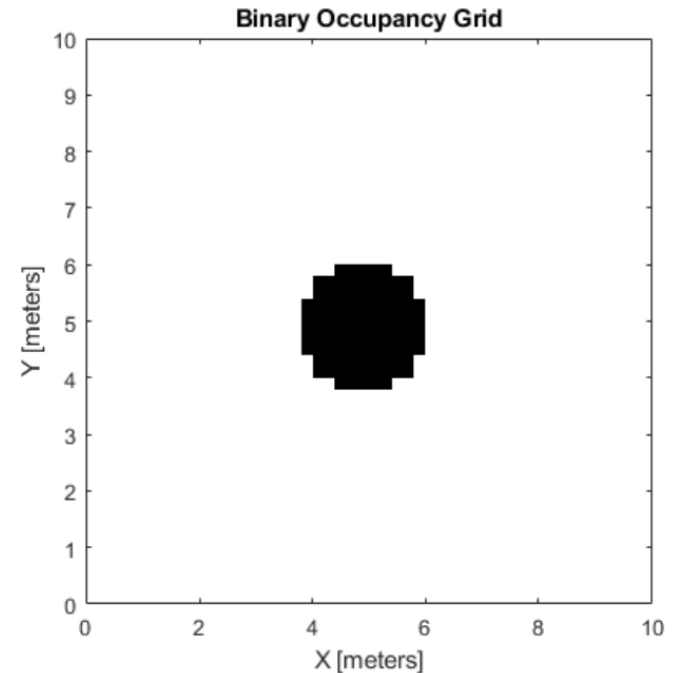
Occupancy Grid

- Each cell may have a counter.
- Counter value of 0 indicates that the cell has not been hit by any ranging measurements and therefore it is likely to be free-space.
- As the number of ranging strikes increases, the cell value is incremented.
- Above a certain threshold, the cell is deemed to be an obstacle.
- The values of the cells are discounted when a ranging strike travels through the cell.

This allows us to represent “transient” (dynamic) obstacles.

Occupancy Grid

- A binary occupancy grid uses true values to represent the occupied workspace (obstacles) and false values to represent the free workspace.
- A probability occupancy grid uses probability values to create a more detailed map representation.





Thank you for your attendance :D

Reference

- *MATWORKS official tutorial.*
- *Lecture slides from RMIT Melbourne Autonomous System course, delivered by Prof Reza Hoseinnezhad.*
- *Introduction to Autonomous Mobile Robots by Roland Siegwart and Ilah R. Nourbakhsh.*

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