	Study online at https://quizlet.com/_df4d0p	
1.	What is localisation?	The process that the robots uses to determine its position in the environment.
2.	What are two ways in which robots can navigate?	Map-based/Model-based navigation AND
		Behavior-based navigation
3.	What is involved map-based navigation?	The robot explicitly attempts to localize by collecting sensor data, then updating some belief about its position with respect to a map of the environment.
4.	What are the pros and cons of map-based navigation?	Pros: - Position is available to human operators - The map, if created by the robot, can be used by humans as well - Ability to scale, and hence change maps
		Cons: - More up-front development effort May go diverging even if the raw values are transiently incorrect
5.	What is involved in behavior-based navigation?	This approach suggests designing sets of behaviors that together result in the desired robot motion.
6.	What are the pros and cons of behavior-based navigation?	Pros: - Avoids inaccuracy of mapping - Easy to implement (if works) Cons: - Does not directly scale to other or larger environments - Must be carefully designed to produce

Localisation

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		the desired behavior. - May have multiple active behaviors at any one time, which can confuse the robot
7.	What are the ways in which we can represent maps?	
		- Cell decomposition (Exact, Fixed, Adaptive):
		- Topological map
8.	What is the continuous line-based representation of a map?	Involves representing the map with a set of finite/infinite lines. It operates under the closed-world assumption (i.e. only need to store information of the lines).
9.	What are different assumptions we can make about the environment?	Closed-world (CWA): What is currently not true, is false.
	ment:	Open-world (OPA): What is currently not true, is either true or false.
10.		It involves drawing vertical/horizontal lines through vertices of obstacles. This tessellates (cover with polygons) the space into areas of free space.
11.	What are the pros and cons of exact-cell decomposition (polygon)?	Pro: Can be extremely compact Cons: The information of the obstacle and free space may be expensive to collect.
12.	What is the fixed-cell decomposition representation of a map?	It involves tessellating the world, transforming the continuous real environment into a discrete approximation for the map.
13.		Occupancy grid.



Localisation

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What is a popular version of the fixed-cell decomposition representation of a map?

The environment is represented by a discrete grid, where each cell is either filled (part of an obstacle) or empty (part of free space).

14. What are the pros and cons of the Pro: Easy to implement for robots with occupancy grid method for repre- range-based sensors senting a map?

Cons:

- Narrow passages may dissappear
- Huge memory may be needed

15. What is the adaptive-cell decom-

Assume a resolution $1/(4^x)$ (x > 0). We position representation of a map? start off with x = 1, where we will have 4 rectangles cover up the map. IF any rectangle has only fere space, then the cell does not decompose. Otherwise, we increase x to 2 and break each remaining cell into 8 cells, and the process repeats until a predefined resolution is met.

16. What is the topological map repre- It involves representing the environment sentation of a map?

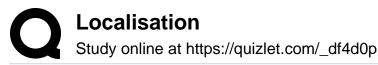
with nodes and edges. The key feature is that it maintains topological relationships (connectivity). Although it lacks scale and distances, it does adapt to geometric change.

17. What are the 2 categories of local- Global localization: isation?

- The robot IS NOT told its initial position.
- Its position must be estimated from scratch.

Position tracking:

- A robot KNOWS its initial position. It just needs to estimate the displacement relative to the initial position.



What are the four different localisation methods?

- Localization based on landmarks/artificial markers/sensors.
- Dead reckoning/Odometry.
- Map-based localization (probabilistic).
- Simultaneous Localization and Mapping (SLAM).

19. What is localization via landmark/artificial markers/sensors?

Landmarks are generally defined as passive objects in the environment that provide a whole degree of localization accuracy when they are within the robots' field of view.

The control system for a landmark-based navigator consists of two discrete phases.

LANDMARK IN VIEW:

The robot localizes frequently and accurately, using ACTION UPDATE and PERCEPTION UPDATE to track its position without cumulative error.

LANDMARK NOT IN VIEW:

Only ACTION UPDATE occurs, and the robot accumulates uncertainty until the next landmark enters the robots' field of view.

20. What is dead reckoning and odometry?

Dead reckoning is a simple mathematical procedure for determining the present location of a vessel by advancing some previous position through known course and velocity information over a given length of time.

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21 W	hat are the sources of error

Odometry is basically dead reckoning with only on-board sensors (e.g., wheel encoders and IMU's), sometimes interchangeable with dead reckoning.

21. What are the sources of error when we use dead reckoning?

DETERMINISTIC (Systematic):

- Misalignment of wheels
- Unequal wheel diameter

NON-DETERMINISTIC (Random):

- Variation in the contact point of the wheel
- Unequal floor contact (e.g., slippage, non-planar, etc.)

22. How can we the deterministic (systematic) errors?

Through calibration

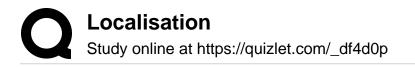
CALIBRATING WHEEL RADIUS (r):

- 1. Make deltaTheta_L = deltaTheta_R = constant (pure translation).
- 2. Tune the constant (i.e., the rotation angles of both motors until the robot moves to the center of the next cell)
- 3. Calculate r from the formula of deltaS.

(NOTE: Make calibration accurate by moving the robot for a longer distance)

CALIBRATING AXLE LENGTH (I):

- 1. Make deltaThetaL = -deltaThetaR = constant (pure rotation).
- 2. Tune the constant (i.e., the rotation angles of both motors until the robot rotates to a certain angle e.g., 360 degrees).



3. Calibrate I from the formula of delta-Theta

(NOTE: Make calibration accurate by rotating the robot for a further angular displacement)