Localisation

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

		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?**	- Continuous line-based - 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. Open-world (OPA): What is currently not true, is either true or false.
10.	**What is the exact-cell decomposition (polygon) representation of a map?**	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.

	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 occupancy grid method for representing a map?**	Pro: Easy to implement for robots with range-based sensors Cons: - Narrow passages may dissappear - Huge memory may be needed
15.	**What is the adaptive-cell decomposition representation of a map?**	Assume a resolution 1/(4^x) (x > 0). We 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 representation of a map?**	It involves representing the environment 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 localisation?**	Global localization: - 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.
18.		

	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.

		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 (l): 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 l from the formula of delta-Theta

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