Mock Exam

correction

Question **1**

Not yet answered

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Flag question

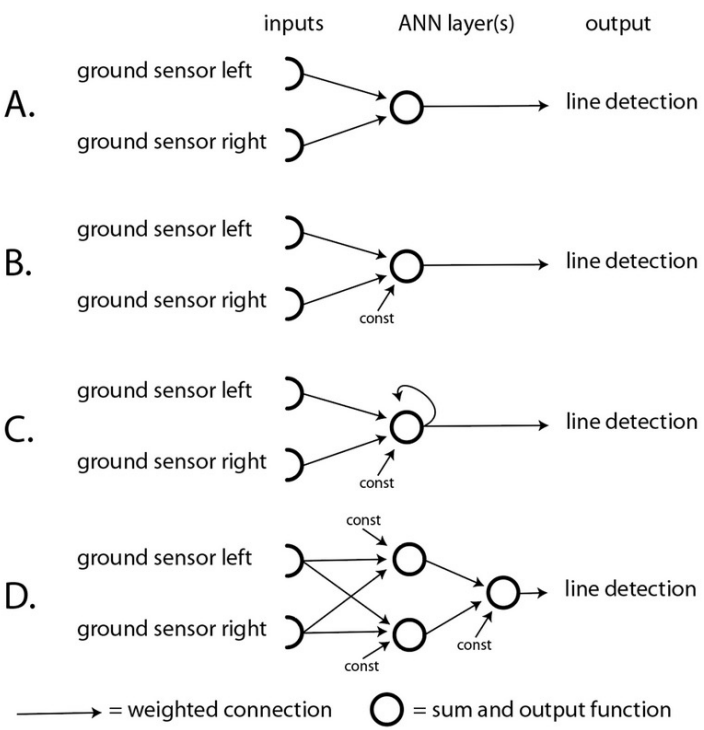
You need to design a robotic system that works in a park, and the sensors need to capture the visual texture and 3D structure of the environment. You don't have any limit in terms of budget, but you want to use as little computation as possible to insure long autonomy. What sensor do you choose among these?

Select one:

- a. Lidar (radar) ...:.
- b. Kinect 3D camera ....:
- c. Stereo camera ..:..
- d. Single camera ...::

Lidar does not provide texture information.
In a Kinect there is often a standard camera providing texture, but a Kinect would be hard to use outside, as day light has a lot of infrared and would probably not allow the Kinect to work properly.
The stereo camera can provide both texture and depth (c is the right answer).
The single camera can get depth too if you have a specific pattern (here we could perhaps imagine it is the case) but then it requires much more computational power.

You are asked to design a neural network that is able to detect when one of the two ground sensors of the Thymio robot detects a black line on a white background. In short, when one of the two sensors detect black, the output of the network should be “1”, otherwise be “0”. This implies a binary output function on the output layer and a linear output function in the hidden layers. Which of the following neural network architecture is the minimal one to achieve this task?



Select one:

- Structure A
- Structure B
- Structure C
- Structure D

The function that the ANN should make is a XOR. A single layer of neurons is just a linear separator and cannot generate a XOR pattern, therefore only the D structure can perform this task.

Question **5**

Not yet answered

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Active beacons for indoor consumer use (home) that project patterns on the ceiling are ... (multiple choices possible)

Select one or more:

- a. . . . a bad idea because active systems in indoor situations can cause perturbations also for a single robot ....:
- b. . . . interesting because simplifying the detection and therefore reducing the price of the whole system ...::
- c. . . . not often used because requiring a complex receiver and signal processing system ...:.
- d. . . . interesting when you need to be as independent as possible from the environment ..:..
- e. . . . interesting because simplifying the detection but increasing the price of the whole system ..:.:

a. NO, For a single robots I do not see any possible perturbations
b. NO, the detection is simplified but the price of the whole system is increased by the presence of the emitter
c. NO, the receiver is simplified by the specific signal emitted
d. YES, because of the very specific signal emitted
e. YES, simplified detection but price increased by the emitter

Question 7

Not yet answered

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You work for a company in charge of the security of a main car tunnel. They want to develop a drone that can enter the tunnel in case of fire, and deliver high resolution images of the situation. They want to use the vision also for navigation, looking at the ground lines. In case of fire the lines can be affected in very different and mostly unknown ways depending on the type of fire, etc. and what it's important is to know when the line cannot be detected anymore by the system. Which approach you use for this computer vision task of identification of the line?

Credit: Rex Features

Select one:

- Classical computer vision methods
- Machine learning techniques

The fact that we need to know the limitations of the system, implies that the system need to be transparent and able to give a reliability in the measure. Moreover we do not have samples as we do not know how the line can be affected (unknown) and therefore we cannot train the system.

Question **9**

Not yet answered

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You have been hired as a robotics consultant by an investor who need to choose where to invest among three innovative car companies. All three want to create the first true autonomous car by innovating at several levels, including type of mobility. One feature they want to introduce is fast lateral parking, which is an issue in classical cars. Which one would you **not** support, considering that the proposition does not make any sense?

Select one:

- a. Company B suggests to keep degrees of freedom and mobility but add AI algorithms to improve control ....::
- b. Company C suggests to increase the degrees of mobility by implementing a fully new type of tires ....:
- c. Company A suggests to add degrees of freedom to the car by adding actuators ...:.

Company B has a reasonable suggestion, adding AI could perhaps help.
Company C wants to add a better control of the DOF increasing the degrees of mobility, is possible.
Company A has a suggestion that makes no sense at all: DOF are constant, only DOM is affected by the number of actuators.
Answer c. (this is the company NOT to support) is correct.

Question **11**

Not yet answered

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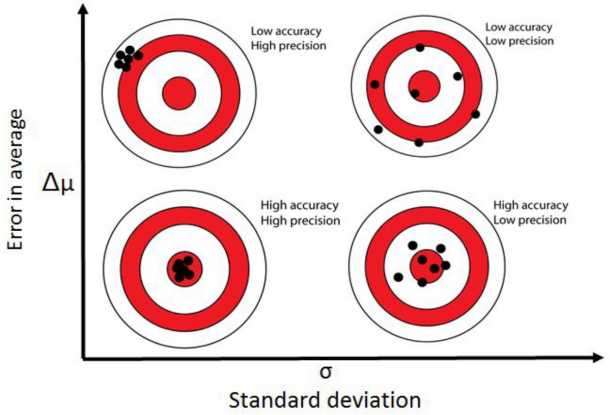
You design and produce a simple robot moving in all-terrain conditions. To measure the inclination of the robot you use an accelerometer. During production you observe that the soldering of the accelerometer introduces offsets in the inclination. Here a set of soldering situation among the same production.

What do you do?

Select one:

- a. Inclination just impacts accuracy, my system will work introducing a calibration in each robot ...::
- b. Inclination just impacts precision, my system will work introducing a calibration in each robot ....:
- c. Inclination impacts both the precision and accuracy of my system, I can average the mea-surements and add calibration to correct the problem ...:.



Accuracy relates to the offset from the desired measurement and can be corrected by a calibration (answer a is correct). Precision cannot be corrected by a calibration. It can be corrected by a mean if there are sufficient samples, but in general this reduces the sampling frequency and is not a trivial solution.

Question **13**

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In the design of a robot that needs to localise itself, you hesitate between putting an encoder on the motor, which is expensive, and the use of an IMU, which is much cheaper. Which of the following arguments (several possibilities) are correct?

Select one or more:

- a. For a simple linear movement, encoders are better than an accelerometer, as the accelerometer requires double integration ....:
- b. The IMU is better for kidnapping situations ..:.:
- c. Both solutions integrate errors and drift in the long run ...::
- d. Encoders are great because they do not introduce drift on the position estimation ...:.
- e. For rotations, where encoders are not very precise, the simple integration of a gyro is interesting ..:..

a. YES, it is true that encoders give direct access to position, while the accelerometer require double integration.
b. YES, if you do not touch the ground anymore in a kidnapping situation, the IMU could allow you to follow the displacement.
c. YES, both solutions drift, the encoder because of the error of contact with the ground, the IMU because of the integration of measurement errors.
d. NO, encoders drift also in position estimation because of the wheel which is an imperfect contact to the ground (slipping, diameter errors, etc).
e. YES, as encoders are worse in rotation than in linear movements, and gyroscopes can be more precise than encoders in rotation in spite of the integration

Question **15**

Not yet answered

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For a specific mobile app, we would like to make the estimation of the position of an automatic shuttle for a passenger of a shuttle making the link between two airport terminals defining a state (position, absolute speed, direction), using a map that includes the position of several visual landmarks and the many different slopes, the slope sensor of the smartphone and the camera detecting the markers. What filter should I use?

Select one:

- a. Particle filter ...::
- b. Kalman filter ...:.
- c. Grid-based filter ....:

Direction is binary and therefore cannot be modelled with a gaussian distribution. Therefore no b. Grid based filters scale badly. Therefore no c. The more interesting solution is a.

Question 17

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For an exercise of this course, one of your colleague designed a artificial neural network (ANN) to implement local obstacle avoidance on Thymio. The learning algorithm used by your colleague to set the weights of the ANN consists in initializing randomly the weights of the network and moving around for a fixed amount of time in a setup full of obstacles and with a movement controlled by the ANN, updated at 10Hz.

1. If none of the sensors saturates and if the robots moves at least at 2cm/s, the conditions are considered “GOOD” and the network weights are reinforced with a very small learning rate.
2. If one sensor saturates, the mode of the learning algorithm turns to ”BAD, OBSTACLE”: the last 10 network inputs are taken and the weights are reinforced a bit toward turning on the spot clockwise at a speed of 1 rad/s.
3. If the robots moves too slowly (<2 cm/s), the mode ”BAD, SPEED” reinforces a bit the weights associating them with a speed of 3cm/s.

What type of learning is this, and what type of algorithms are associated?

Select one:

- Having target speeds reflects a classical supervised learning, where we can compute an error and apply gradient descend.
- The two main modes “GOOD” and “BAD” reflect a classical reinforcement learning
- This is a mix of reinforcement learning (“GOOD” state) and supervised learning (both “BAD” states)
- None of these answers is correct.

The point 1 is a reinforcement type of learning, without a defined output for a given input, but the situations 2 and 3 are a supervised learning (both inputs and outputs are known). Therefore this is a mix (third answer is correct).

Question 19

Not yet answered

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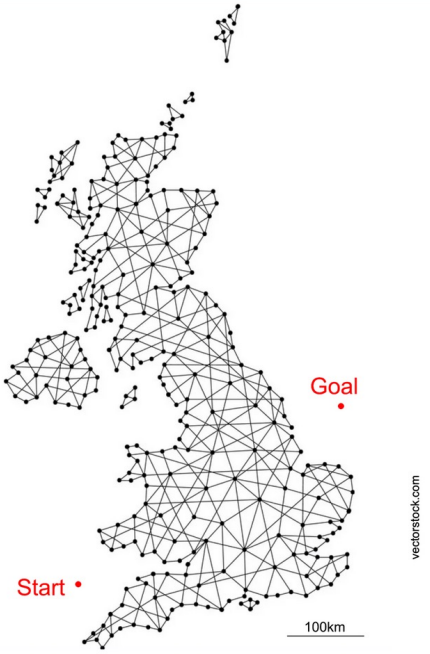
You have to design the navigation algorithm for a robotic ship that navigates around the UK, outside the territorial waters (22km from the coast), based on the vector map on the right. Which of the statements below are correct (multiple correct answers possible)?



Select one or more:

- [ ] Potential field navigation would not work here, as there are possible local minima.
- [ ] Voronoi diagrams need the information of the limits of the sea, not available in this map.
- [ ] Visibility graphs applied to the borders extended by 22km could generate optimal paths.
- [ ] An occupancy-grid map with cells of 10km of side and a A* path search could work, but the path would not be optimal.

A – yes, there are local minima due to the shape of the coast
B – yes, Voronoi diagrams are based on equidistant points between two limits, here there is no outside limit
C – yes, this is the optimal path around the territorial waters
D – yes, this is suboptimal because of the approximation of the cells