Some remarks on Mock TCA

Question 1: Reactive Robot Behaviours [50 marks]

a. [10 marks] Explain the concept of Braitenberg vehicles. Design and explain a Braitenberg vehicle that will be scared of light, assuming a robot with two light sensors and two wheels.
   - Architecture/wiring schema
   - Explanation of the drawing (what do + and – mean, etc)
   - A reactive behaviour

b. [20 marks] Describe, in your own words, the difference between the "data pull" and "data push" communication models.

   Explain which model is used in ROS and how communication between the components works.

   Use an example of a "laser" node that returns distance readings from a laser scanner, and a "behaviour" node that receive this data to illustrate the processing (no need to write Python code, but please explain the processing, e.g. using pseudocode or a graphical representation).
   - Data push
   - Talk about topics, subscribers, publishers
   - Include a graph of nodes for the example
   - Talk about callbacks, asynchronous processing,…

c. [20 marks] Which sensor could you use to develop a wall-following robot, *[… this is about solving a specific use case, the question is not complete*]
   - laser, IR distance sensor, time of flight sensors, sonar
   - again, include figure
   - …

Question 2: Navigation (50 marks)

a. *[… some basic question about navigation strategies, e.g. path integrations, dead-reckoning, also in biological systems. Discuss the limitations of such approaches and possible strategies for overcoming these limitations]* (12 marks)
   - maybe about animals' navigation strategies
   - odometry
   - visual homing

b. Describe the key features of topological and metric maps, and discuss the issues involved in building these different types of maps by an autonomous mobile robot (18 marks)
   - Contrast the two (maybe in a table)
   - Use a grid-map as an example for a metric map
   - Topological map is a graph, talk about nodes and edges, what they represent
   - Topological: Record of the connections (links) between a set of places (nodes)
   - Metric Maps: Record of the location of objects in an absolute coordinate system

c. A mobile robot is equipped with odometry sensors (wheel encoders) and a forward-facing Kinect sensor, which is capable of providing both colour vision and depth information. Assume that the robot has already acquired an accurate and up-to-date 2D metric map of the environment using the same sensors and an appropriate mapping algorithm. The robot is deployed as a security patrol robot in an office environment consisting mainly of corridors, with many places that appear similar to the robot due to perceptual aliasing and the limitations of the robot's sensors. Your task is to describe an appropriate self-localisation algorithm for tracking the 2D pose of the robot during operation. Which state values will be estimated by your algorithm? (4 marks)
   - Robot's pose, X, Y, Theta

   Please explain the main steps of the tracking algorithm using equations, pseudocode and/or diagrams as appropriate, taking care to properly describe the inputs and resulting outputs of each step (16 marks).
   - Predict-sense-update
   - Ideally, show the probability distribution changes, and the formulas
   - Talk about "particle filtering"

Question 3: Human Robot Interaction (50 marks)

a. Define embodiment, explicit interaction and implicit interaction between humans and these embodied machines. Explain explicit interaction and provide two specific examples for this type of interaction. (12 marks)
   - Check definitions: explicit (action performed with the purpose of eliciting a reaction), implicit (Actions are modified due
   - to presence of another)
   - give the two examples

b. Considering both the computer science and social science point of view, list the pros and cons of using a 'Wizard of Oz' experiment versus an experiment with a fully autonomous robot. Give one example of a study where you would use 'Wizard of Oz', and another example of a study where you would use a fully or partially autonomous robot. For each example, explain why you would choose this approach. How would choosing the "wrong" modality influence the findings of your studies, and why? (18 marks)
   - Check slides explicitly listing pros and cons and list a few
   - WoZ to study human reactions to a specific stimuli, autonomy when, for instance evaluating a new mapping approach, etc.

c. *[… some question about a specific HRI sub-topic, e.g. proxemics or human-aware navigation, attention,…. Describe the concept, explain its specifics (models and implementation considerations), and its application in robotics?]* (20 marks)