### ***Question 1.1 - Your company decided to use ROS for the development of a commercial self-driving vehicle. You are supposed to present the advantages and disadvantages of this design decision to your team. List and explain two advantages and two disadvantages.***

*Advantage 1: Easy to prototype.*

*Advantage 2: Functional units are loosely coupled.*

*Advantage 3: It comes with an easy-to-go code, so you don’t need to build everything from scratch as it is unlikely that everyone could code everything by themselves.*

*Downside 1: Not real time (ROS 1).*

*Downside 2: Unsuitable for mass production.*

*Downside 3: Overhead of message communications between nodes (nodelets resolve this to some extent).*

*Downside 4: No safety guarantees*

***Question 1.2 - Your management is trying to decide if they want to have teleoperation (remote control) for the self-driving car. List and explain one pro and one contra argument for the teleoperation. Which communication channels would you use for the V2X and why?***

*Teleoperation is the remote control of a robot.*

*Adv-human interference in autonomy to deal with out of training data situation (rare situation)*

*Disadv- latencies, unpredictable and fast changing network conditions.*

*V2X use WLAN, bcoz it includes V2V and V2I communication without requiring V2N, thus no communication infrastructure required which assure safety in remote or little developed areas.*

### ***Question 1.3 - Your system architects are trying to figure out how to achieve functional independence in their self-driving car design, and they have asked you for your thoughts. What impact does functional independence have on ADAS development for vehicles with regards to combinatorial optimization and vendor optimization? How is this different for self-driving car development?***

*Make individual testing of functions (modules) independent of each other. Thus simplifies selling separate units to customers and employing various suppliers.*

*AD requires connection between these individual systems to ensure conflict free functions.*

***Question 1.6 - You are supposed to design a sensor-set for a self-driving car. You are told that the self-driving function will only be used for highway driving in Germany. How does this restriction to highway driving change the requirements for your sensor-set design, as opposed to city driving? List 4 specific properties of this scenario and how they impact the sensor-set design.***

*Answer:*

*(Short range sensor will be required as opposed to long range used on highways)*

*1: Limited Speed: it may not be necessary to have the sensor which has a very high detection range to detect other vehicles at super early time.*

*2: Has intersection: the sensors should have a wide field of view (e.g. rotation 3D LiDAR) which covers the crossing width of the intersection.*

*3: Has parking scenarios: Needs sensors that are precise at low distances, such as FMCW radars and bird-eye-view cameras.*

*4: Traffic lights/signs (RGB cameras are required to detect them) Color detection of the lights with a camera is necessary to determine if the vehicle should pass (green light), ready to stop (yellow light), and stop (red light).*

*5: Multiple object detection (Pedestrians, traffic lights, etc): Better quality on object recognition and faster reaction as pedestrians can cross in front of the car suddenly.*

***Question 3.1 - You are given responsibility for a team of 6 multi-sensor-data-fusion experts. Management wants you to define requirements and tasks for the team in order to achieve good results for the self-driving car. Because management has just given you this responsibility, they still want you to explain your resulting requirements and tasks to them. Following, you find a number of design***

***options. The self-driving car is supposed to drive autonomously on highways in Germany only. Choose one design option for each (What?), explain your choice (Why?), and list an advantage and a disadvantage for your choice.***

*Answer:*

*Occupancy grid map vs Polygon based map (expressing occupancy through a variety of polygons*

*instead of rectangular grids):*

*Polygons, bounding region can speed up collision checks by reducing number of edges that has to compared*

*Disadv- not work for non convex polygons.*

*Deep learning based end-to-end object tracking vs Kalman filter:*

*Kalman filter, bcoz although deep learning end to end it's a black box and difficult to find out why N.N gives that result.Kalman filter is just simple state estimation of dynamic system.*

*Disadv- works for linear model, have to use non linear EKF and UKF.*

*Only front wheels can steer vs front wheels and back wheels can steer (2 wheel steering vs 4 wheel*

*steering):*

***Question 3.8. To perform the multi-sensor-data-fusion in your vehicle, you are supposed to choose between centralized, decentralized and distributed fusion architectures. Choose one of these for your highway driving self-driving car, explain it and describe one advantage and one disadvantage of your***

***choice. Finally, you are supposed to give related requirement to the E/E-architects. Which hardware do you suggest to run the fusion with as part of the E/E-architecture, which bus systems and general network architecture do you suggest to use? Explain each choice and requirement****.*

*Answer:*

*Distributed*

*Adv-Communication cost not high like that of decentralized system, not suffer from scalability problem when number of nodes increased.*

*Disadv- local views fused to get global views, so if error in local view whole global view affected.*

*follow the format….*