1. ---

Title: Application of reinforcement learning to the control of an autonomous vehicle.
Explanation: Design of autonomous vehicle control algorithms based on reinforcement learning and simulators.
Others Involved: Angel Madridano, Abdulla Al Kaff, Martín Palos.
Difficulty: alta.
Competencies: Linux, Python, ROS.
Responsible: Fernando Garcia, fegarcia@ing.uc3m.es

2. ---

Title: Medical imaging detection based on semantic segmentation.
Explanation: Design of pathology detection algorithms in medical images using public datasets, Kaggle type.
Difficulty: medium.
Competencies: Linux, Python, ROS, OpenCV.
Responsible: Fernando Garcia, fegarcia@ing.uc3m.es

3. ---

Title: Detection of driver's drowsiness using CNNs.
Explanation: Development of drowsiness detection algorithm based on convolutional neural networks.
Difficulty: medium.
Competencies: Linux, Python, ROS, OpenCV.
Responsible: Fernando Garcia, fegarcia@ing.uc3m.es

4. ---

Title: Monitoring of vehicle traffic in a controlled environment by means of fixed radars using a simulator.
Explanation: Vehicle detection algorithm design in a controlled environment.
Difficulty: medium.
Competencies: Linux, Python, ROS, OpenCV.
Responsible: Fernando Garcia, fegarcia@ing.uc3m.es

5. ---

Title: Container state detection and analysis based on neural networks.
Explanation: Development of container state detection algorithm based on convolutional neural networks.
Others Involved:Sergio Campos.
Difficulty: medium.
Competencies: Linux, Python, ROS, OpenCV.
Responsible:Abdulla Al-Kaff, akaff@ing.uc3m.es

6. ---

Title: Generation of digital 3D environments using LIDAR information for their use in the digital twin of an autonomous car.
Explanation: Generate 3D digital environments, duplicates of real environments, using data collected from the LiDAR of a real autonomous vehicle, in order to use these environments for conclusive testing with a digital twin inside a simulated environment.
Difficulty: Medium.
Competencies: C++ or Python (required) + Blender, Meshlab or other 3D modelling software (strongly recommended, but not required) + ROS (recommended, but not required) + Linux (recommended, but not required).
Responsible: Martín Palos Lorite, mpalos@ing.uc3m.es.

7. ---

Title: Development of a supervision and control IoT system for 3D printers.
Explanation: Implementation of the necessary software and communication architecture to enable remote monitoring and control of a 3D printer. It will also include the design and construction of all the necessary elements using the printer itself.
Others Involved: Dr. Abdulla Al-Kaff, Dr. Ángel Madridano
Difficulty: Average
Competencies: Linux-based operating system (recommended), 3D modeling (recommended), 3D printing (recommended).
Responsible: Sergio Campos Novoa,secampos@ing.uc3m.es

8. ---

Title: Interconnected sensor system for traffic monitoring
Explanation: To develop an algorithm capable of gathering images from several RGB cameras, detecting vehicles and pedestrians, performing 2D tracking on the image, projecting objects on the ground, matching several cameras and sending alerts in case of collision risk situations.
Others involved: Dr. Abdulla Al-kaff, Martin Palos
Difficulty: average-high
Priority: medium
Skills: Linux, Python, ROS, OpenCV, (Arduino)
Responsible: Armando Astudillo Olalla, aastudil@ing.uc3m.es

9. ---

Title (TFM): Measuring your measurements
Description: Develop a machine learning method that is able to learn the measurement (sensor) model of any generic detection algorithm.
Application example: We have a landmark detection algorithm (based on LiDAR), but we need to know how good are those detections (error modelling) to use them in a localization module. The detection error is likely to depend on the distance to the object, its size, etc. This algorithm can also be used with any other object detection algorithm if an estimation of the detection error is required.

The main idea is to build a simulation environment where we can obtain measurement data with the objects to be detected in different positions. The obtained data will be used to learn the statistical model of the measurement error.

Difficulty: Very high

Competencies: Linux, Simulation environments (Gazebo or Carla), python, statistics and machine learning (regression / neural networks).
Responsible: Francisco Miguel Moreno,franmore@ing.uc3m.es .

10. ---

Title: Landmark-based localization algorithm for autonomous vehicles
Description: Implement an algorithm in C++ that solves the Nonlinear Least Squares (NLLS) system produced by a set of multiple landmark measurements; in order to estimate the position of the vehicle from which the measurements were taken. The algorithm must be able to run at a minimum of 10Hz, even with a high number of landmarks (up to 15). It is recommended to use an optimization library such as g2o to avoid reinventing the wheel. A basic preliminary version of this localization algorithm has been already implemented in python using the lmfit library, and it will be provided as an example to implement the more efficient C++ version. The final version must be integrated in ROS (Robotic Operating System).

Difficulty: Medium/High
Competencies: Linux, ROS, C++, Optimization.
Responsible: Francisco Miguel Moreno, franmore@ing.uc3m.es

11. ---

Title: Data selection with Active Learning for dataset creation
Description: Active Learning is a machine learning technique that allows the selection of data that needs to be labeled to obtain the best results in the training of a supervised model. It is used in situations where the amount of data is too large to be fully labeled and a certain priority needs to be given to label the data that will be most useful.
Difficulty: Very high
Competencies: Autonomy, Problem solving, Linux, Python, (Machine learning), (Neural networks), (Perception datasets).
Responsible: Irene Cortés Lafuente, irecorte@ing.uc3m.es
Observations: Starting in April

12. ---

Title: 2D map generation based on segmented pointcloud.
Explanation: Develop a C++ algorithm that is able to generate a 2D map of the surroundings based on the segmented pointcloud and GPS localization. The pointcloud includes spatial information (X,Y,Z) and the class it belongs (traffic sign, road marks, etc). The 2D map is generated by transforming and accumulating the received pointcloud. The developed algorithm will be integrated in a real autonomous vehicle for testing.
Others Involved: Fernando García.
Difficulty: Medium
Competencies: C++ (high level required) + ROS (recommended, but not required) + Linux (recommended, but not required).
Responsible: Miguel Ángel de Miguel, mimiguel@ing.uc3m.es