Assignment1

Q1.
Part-Picking robot environment properties:

- **Partially observable**: the camera could not be able to show the whole content of the bins, but just their characteristics (which parts belong to each bin). Despite having quite a good idea of the parts to grab, it does not have any information on the conveyor belt (speed, parts arrival rate, ...). Another missing information is related to the parts weight which could be important when deciding how to grab the items.
- **Single-agent**: we have just one robot and both the conveyor belt and the parts do not try to maximize their own performance measure, since they are just objects behaving according to the laws of physics.
- **Stochastic**: there are a few reasons why this environment can be defined as stochastic. First, the choice related to where to place the parts could be subject to some inaccuracy percentages, meaning that the robot could correctly recognize one part with a given probability. The other reason is related to the fact that the robot itself could fail (the moving arm could break) and these fail probabilities can be defined by the producer.
- **Episodic**: clearly the episodes match the parts. When a new part is detected by the robot, it analyzes it and makes a decision on where to place it. This is independent on the previous analyzed parts since each decision just considers the single part.
- **Dynamic**: the fact that the parts keep flowing on the conveyor belt makes the environment dynamic since the robot has to keep scanning the environment to get updated information about it.
- **Continuous**: the robot's moving arm keeps moving so its position is not fixed in time. It can be in many different continuous positions.

Q2.
Robotic-soccer environment PEAS description:

- **Performance measure**: maximize scored goals, minimize conceded goals, follow rules, respect game time, play safe, minimize received cards and fouls.
- **Environment**: soccer field, spectators, ball, opponent team, goals, referee, weather.
- **Actuators**: "moving" motor (to move the robot around the field), head actuator (to look around and to kick the ball), legs actuator (to kick and control the ball).
- **Sensors**: cameras, GPS, gyroscope, accelerometer, proximity sensor (for distance measurement and collision avoidance), infrared sensor (for distance measurement and object detection).

Q3.
A **rational agent** is an entity capable of detecting the surrounding environment through sensors and who tries to maximize its own performance measure by acting through actuators. These actions are taken based on the gathered information through the sensors (perceptions) in order to maximize the reward function from now until a predefined time horizon.

An **autonomous agent** is an agent characterized by autonomy or adaptability. Such agents rely on previous knowledge deriving from the creator and try to integrate it with new information deriving from the surrounding environment. In this way, as time passes an autonomous agent should also be able to correct eventual incorrect prior information.

Q4.
Vacuum cleaner agent.

a) To decide whether to modify the current agent program or not we first need to consider the performance measure. Since the agent is awarded one point for each clean square at each time step, we need the agent to keep the 2 locations clean as long as possible.
   Given these considerations, it better to leave the current agent program unmodified since, when the agent has just cleaned up one location it actually makes little sense to just stay in the same location. This is because the agent does not have any idea on the presence or not of dirt in the other location. It's then better to switch square at each time so that, in case the other location is actually dirty, the number of clean squares is increased and so does the overall reward.
b) The main issue here is partial observability which limits the agent's environment knowledge. We could switch to a model-based reflex agent so that the agent itself can keep a state of the previous observed information of the environment. In this way, it can acquire further knowledge on how the environment evolves and, specifically, on how frequently the dirt appears in a square after cleaning it.
   Now that the agent can learn new information and has an idea on when to expect the dirt to appear in a given square, it can combine this acquired knowledge with the sensed information from the current environment (through sensors) to reduce the number of movements between squares by applying, in some cases, the NoOp action.