1.
a)
- Performance : Arrive the destination in shortest path, deliver the food without damage, avoid the obstacles and not to hit people in the process of delivering.
- Environment:
  - o Known: geography of environment (the map of OSU), initial location (Memorial Union)
  - o Unknown: Distribution of people in OSU, people's future behavior around the robot
  - o Low probability: Threat of robot, cancel of order during the delivery.
- Actuators: The motor of Starship robot
- Sensors: Location sensor(GPS) and radar sensors

b)
- fully vs partially observable
- deterministic vs stochastic
- episodic vs sequential
- static vs dynamic
- discrete vs continuous
- single vs multi-agent

First of all, the robot is partially observable because although the robot knows the entire map of OSU, the robot cannot observe the entire distribution and future behavior of people in OSU.
Second, the next state of environment is not determined so that it is stochastic. The robot cannot perfectly predict the behavior of surrounding people's behavior.
Third, the robot's current behavior affects to all future behavior so that it is sequential. The robot's change of direction affects the change of the path of the robot.
Fourth, the robot keeps moving while the algorithm decides what to do next so that it is dynamic.
Fifth, the robot's state and action are continuously changing by time, and the decision problem also changes as the time flows. Thus, it is continuous.
Finally, the robot need to avoid collision with another robot and objects so that it is multi-agent.

c) Suggest the most appropriate agent design by choosing the most appropriate of the following agent types:
- simple reflex agent
- model-based reflex agent
- goal-based agents
- utility-based agent

The robot needs to consider the path of the destination, and always do searching and planning in order to reach the destination so that it is goal-based agent.

2. a) An agent must have an accurate model (i.e., encoding of how the world works) in order to be rational.

False. Even if the model is not accurate, the rational agent can update the model by information gathering.

b) A rational agent will always win a game of rock-paper-scissors.

False. A rational agent should select an action that is expected to maximize the performance so that the rational agent can choose not to loose a game of rock-paper-scissors in order to maximize the performance in the game.

c) Suppose that an agent selects randomly between two actions. There is a stochastic environment where the agent is rational.

False. For instance, if Starship robot only randomly does go forward or backward, then it can hit the object or stuck in the process of delivery, which is not rational.

d) An agent that is not rational in one task environment may be rational in another.

True. For instance, AlphaGo is rational in playing game of go, but not rational in playing chess.

3. Consider a modified version of the vacuum environment:
   • Performance measure: one point awarded for each clean square at each time step.
   • Environment: geography of the environment (its extent, boundaries, obstacles, etc.), and initial location are known. Dirt distribution is unknown. Clean squares may become dirty again with a low probability each time step.
   • Actuators: Suck cleans dirt, Left moves left, Right moves right, Up moves up, Down moves down.
   • Sensors: Location and dirt sensors.

   a) What is the optimal behavior for an agent in this environment?

   The optimal behavior for an agent is sensing the dirt, cleaning the square by sucking dirt(not doing this action if the square is clean), and then moving to another square. After moving to another square, the agent repeats the steps which the agent did in the previous square.

   b) Can a simple reflex agent with a randomized agent function be rational for this environment? Why or why not?

   The simple reflex agent with a randomized agent function cannot be rational for this environment. Since the agent knows its initial location and geography of the environment, the agent can do sophisticated decisions. However, the agent is determining the action depending on the randomized agent function so that the agent is not using the prior knowledge of environment which can maximize the performance. Therefore, the agent is not rational for this environment.

   c) Consider the probability that a clean square will become dirty again. Is there a probability for which a simple reflex agent with a deterministic agent function can be rational? Explain why not or provide the probability and agent function.

   A simple reflex agent with a deterministic agent function can be rational for this environment. Since, the agent knows the initial location and geography of the environment, the agent can specify the actions depending on the cleanness of the square and current location. Although the probability that a clean square will become dirty again is low, there is a probability that the agent keeps cleaning the squares. Therefore, there is a probability for the agent can be rational.