Dyson School of Design Engineering

DE1-Computing -1, Assignment-2

This assignment carries 60% of the final mark.

This is a Python coding assignment. Please submit your answers as one Jupyter notebook file with code cells or a zip file of separate Python codes for each question. Note that you will get marks for your correct attempts even if the code gives errors for some lines.

Question 1

A robotics company designs legged robots and wheeled robots for agricultural applications. They have a user interface that allows potential users to enter details of their requirements. You have to develop an object oriented program to keep a track of these user requirements, inform custmers what can be made and what cannot be made, and provide an estimate of costs involved.

Question 1.1 [10 marks]

Develop a class called "robot" that takes the following user information:

- Name of the user
- Area of the farm in m^2
- What is grown in the fram
- Terrain conditions (flat, hilly)
- Expected maximum acceleration

Question 1.2 [10 marks]

Extend the above class to inform the user whether the robot can be designed or not based on the maximum expected acceleration, assuming that the company can make robots that can move at a maximum acceleration of $10m/sec^2$ if the terrain is hilly and $20m/sec^2$ if it is flat.

Question 1.3 [20 marks]

Assuming the user's acceleration requirement is within the company's capability, extend the above class with a method to calculate and print the fuel cost to 2-decimal places to cover the farm land based on the following information.

Let the farm area be a. Annual fuel cost = $0.002a^2 + 0.4log(a)$ if the terrain condition is hilly. Annual fuel cost = $0.001a^2 + 0.4a$ if the terrain condition is flat.

Question 2

Question 2.1 [10 marks]

Write a class called "wheeledrobot" that inherits "robot" class. In your wheeledrobot class, ask the user to enter the maximum payload the robot is expected to carry.

Question 2.2 [20 marks]

If the payload is more than 50kg and the farm is in a flat terrain, print that the wheeled robots of the company are not suitable to carry more than 50kg on a flat terrain. If the payload is more than 30kg and the farm is in a hilly terrain, print that the wheeled robots of the company are not suitable to carry more than 30kg on a hilly terrain. If the payload constraints are satisfied, compute and print the maximum torque required in each motor given by $\tau = (40 + M)a$, where τ is the maximum torque per wheel, M is the expected payload, and a is the maximum acceleration.

Question 3

Two players Jack and Billy plays a dice game. They will both start the game with 100 GBP. In each round each player will roll 3 dice each having numbers from 1-6. The person who has the higher score (add the number of the three dice) wins. The winner gets 10 GBP from the other player. If they have the same score, they need to both roll the dice again.

Question 3.1 [10 marks]

Write a class called **player** that has methods to roll 3-dice, to add £10 if one wins and to substract £10 if one loses.

Question 3.2 [20 marks]

Create instances for Jack and Billy. Do the following after 8-rounds of playing.

- print how much money each of them have at the end of the game.
- print how many rounds each of them wins.
- plot the total amount of money each player had at each round. Label x and y axes, add a title for the plot, and show legends for both players.