AIRO4000 – Introduction to Robotics

Lab Exercise 1 – Patrol Analysis System

*** Check Brightspace for due date ***

Introduction

In this assignment, you will design and implement a Patrol Analysis System in Python, applying skills in nested dictionaries, file I/O, random noise generation, and basic data analysis. The program will simulate robot sensor readings during patrols, generate alerts from calculated averages, and reinforce good coding practices including clear naming, structured logic, and documentation.

Objective

The objective of this assignment is to combine data structures, file handling, and algorithmic thinking to create a working patrol monitoring program that processes noisy sensor data.

Learning Outcomes

By completing this assignment, you will be able to:

- Implement nested dictionaries in Python.
- Generate and process noisy sensor data.
- Save and load CSV files programmatically.
- Apply conditional logic to trigger alerts.
- Produce structured output summaries.

Requirements

Create a Python program named `patrol_analysis.py` and write **your full name** in the comments on top. Your code must perform the following steps:

1. Ask the user how many checkpoints to patrol (1–10).

2. For each checkpoint, record noisy readings for front, left, and right sensors.

   - Generate a base reading between 5–25 cm.
   - Add a random noise of ±0.5 cm.
   - There should be a 10% chance of returning 0 to simulate a sensor glitch.

3. Store readings in a nested dictionary and save them to a CSV file.

4. Reload the file and calculate the average of the last 3 readings for each sensor.
5. If any average < 10 cm, print DANGER ALERT for that sensor.
6. Print a patrol summary on your screen showing all readings and alerts.

Your program's output should look similar to this:

```
How many checkpoints to patrol? (1 to 10): 3

--- Patrol Summary ---
Checkpoint 1 -> front: 12.33 cm, left: 18.74 cm, right: 5.58 cm
Checkpoint 2 -> front: 7.81 cm, left: 10.36 cm, right: 23.40 cm
Checkpoint 3 -> front: 5.84 cm, left: 23.25 cm, right: 8.18 cm

--- Sensor Alerts ---
Front: DANGER ALERT average of last three readings is 8.66 cm
Left: OK average of last three readings is 17.45 cm
Right: OK average of last three readings is 12.39 cm
```

Deliverables

You must submit the following via D2L Brightspace:

1. Your completed Python script (`patrol_analysis.py`).
2. A sample CSV file generated by your program.
3. A JPG or PNG screenshot showing the program output in the terminal.

Submission Instructions

Upload all files to the Lab Exercise 1 submission in D2L Brightspace before the deadline.

Rubric Evaluation

Your work will be graded according to the following criteria:

	Points
Submission and program fulfill all requirements	2
Code readability and appropriate comments	1
Correct file I/O operations (CSV file data)	1
Screen output formatting and accuracy	1
	Total: 5 points