Assignment Guidelines:

1. **Any kind of peer plagiarism may result in zero marks in the assignment or be awarded with an 'F' grade in the course.**

Deliverables:

1. **Software Design Report:**
    - Detailed description of system architecture and agent communication protocols.
    - Explanation of the simulation setup and scenarios.
    - Performance analysis and interpretation of results.
2. **Source Code:**
    - Implementation of agents and inter-agent communication using CrewAI and ROS.
3. **Simulation Visualizations and Logs:**
    - Graphical visualizations of the simulation environment.
    - Communication logs between agents during the simulation.

Assignment: Implement a Multiagent System for Campus Virtual Tour

Objective:

This assignment aims to design and implement a multiagent system to facilitate visitors navigating a campus and meeting their hosts. The system will include communication protocols between Campus Incharge (CI) agents and Building Incharge (BI) agents, utilizing the CrewAI framework and ROS for agent implementation and simulation.

System Description:

1. **Agents and Roles:**
    - **Campus Incharge Agents (CI Agents):**
        - CI agents are responsible for navigating (escorting) visitors from the campus entrance to the building where the host is located.
        - CI agents have access to the campus map but do not have access to individual building maps. They need to communicate with BI agents to navigate within a building.
    - **Building Incharge Agents (BI Agents):**
        - Each building has exactly one BI agent responsible for the navigation map of the respective building.
        - BI agents provide navigation assistance to CI agents, disclosing paths from the building entrance to the host's location based on the visitor's authorization.
        - BI agents can deny access if the visitor lacks authorization or if the host is unavailable in the building at that time.
    - **Visitor Agents:**
        - Visitor agents represent people visiting the campus to meet a host.
        - Visitors are guided by CI agents from the campus entrance to the host's location.
2. **Agent Interactions:**
    - CI agents meet visitors at the campus entrance and escort them to the relevant building.

    - Inside a building, the CI agent communicates with the BI agent to get the navigation path to the host's location.
    - If it so happens (as a special case) that a visitor wants to meet the BI agent itself (i.e. the BI agent will need to serve as host), the BI agent (while serving as host to the visitor) will go out of service (OOS) and will not entertain new navigation requests for the specified time.
    - The OOS response will be accompanied by an integer stating the time duration for which the BI agent is out of service. In case the BI agent exceeds the committed time to be out of service, a violation event will be generated.
3. **Performance Metrics:**
    - **CI Agents:** Performance is measured based on the number of visitors entertained and penalties for violation events (e.g., not returning on time to pick up visitors).
    - **BI Agents:** Performance is based on the number of CI agents guided and penalties for violation events (e.g., failing to adhere to the OOS duration).

Implementation Requirements:

1. **Inter-agent Communication Protocols:**
    - Develop message formats for:
        - CI agent's request for navigation paths from BI agents.
        - BI agent's response with navigation paths or denial messages.
        - OOS notifications from BI agents with out-of-service durations.
2. **System Simulation:**
    - Simulate the multiagent system using CrewAI framework and ROS with the following scenarios:
        - Varying numbers and random arrivals of visitors, CI agents, and BI agents.
        - Random assignment of hosts to visitors.
        - Random meeting durations between visitors and hosts.
    - Simulate different path segments with eligible transport modes (vehicle, cycle, walk) within the campus.
3. **Visualization and Logging:**
    - Visualize the campus and building navigation as graphs.
    - Display agent movements and interactions.
    - Print logs of all inter-agent communications, including violation events and performance summaries.
4. **Performance Analysis:**
    - Record the performance of each CI and BI agent, including the number of visitors entertained and guided, violation events, and penalties.

Assumptions:

- A CI agent remembers the building navigation paths (communicated to it by the BI agent) until the visitor is escorted back to the main gate.
- Each visitor meets only one host.
- Maps are represented as graphs with nodes and directional edges indicating traversability.