# Project Report: PEAS-Based Intelligent Soccer Player Agent

**Course:** Artificial Intelligence

**Semester:** 4th Semester

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## 1. Executive Summary

This project demonstrates the design and implementation of an autonomous **Intelligent Agent** within the domain of Artificial Intelligence. The agent is modeled as a soccer player operating in a stochastic and dynamic environment. By applying the **PEAS (Performance, Environment, Actuators, Sensors)** framework, the project illustrates how an agent can perceive its surroundings, update an internal world model, and execute rational decisions to maximize its performance measure. The implementation is written in Python, emphasizing the modularity required for complex AI systems.

## 2. PEAS Framework Definition

In AI, a rational agent's task environment is defined by its PEAS components. This project utilizes the following specifications:

| **Component** | **Description in this Project** |
| --- | --- |
| **Performance Measure** | The objective function used to evaluate the agent's success. It assigns rewards based on utility: +10 for Goal Attempts (shoot), +5 for Teamwork (pass), and +1 for positional efficiency (move/dribble). |
| **Environment** | A continuous, dynamic soccer field (100x70 units). It is stochastic, meaning the state changes (ball velocity and player positions) are not entirely predictable by the agent. |
| **Actuators** | The mechanisms through which the agent acts upon the environment: moving, shooting, passing, and dribbling. |
| **Sensors** | The perceptual inputs providing raw data: relative distances to the ball, goal, and opponents, along with game state variables like time and current score. |

## 3. AI System Architecture

The agent is built using a modular architecture that mirrors the cognitive process of a **Model-Based Reflex Agent**.

### 3.1 Stochastic Environment Simulation (SoccerEnvironment)

The environment serves as the simulation engine. It handles:

* **State Space:** Managing the coordinates of all entities on the field.
* **Dynamics:** Updating ball position based on physics (velocity) and simulating the "noise" of a real match through periodic random state updates.

### 3.2 Cognitive Processing Modules

1. **Perception Module (PerceptionModule):** Interprets raw sensory input. In advanced AI, this would involve computer vision or signal processing; here, it structures raw numerical data for the agent's internal logic.
2. **World Model (WorldModel):** Crucial for agents in partially observable or dynamic environments. It maintains an internal representation of "how the world evolves," allowing the agent to track state changes over time.
3. **Decision-Making Module (DecisionMakingModule):** The agent's "brain." It contains the knowledge base and inference rules used to map the current state to a rational action.
4. **Action Execution Module (ActionExecutionModule):** The output interface that translates the selected logical action into an environmental command.

## 4. Rational Decision Logic

The agent utilizes a rule-based inference system to achieve its goals. The logic is designed to optimize utility based on specific environmental conditions:

* **Movement Logic:** If distance\_from\_ball > 20, the agent infers it is out of play and prioritizes reaching the ball.
* **Goal-Oriented Logic:** If distance\_from\_goal < 10, the agent recognizes a high-probability scoring opportunity and executes a shoot action.
* **Adversarial Avoidance:** If distance\_from\_opponent < 5, the agent perceives a threat of possession loss and chooses to pass.
* **Default Utility:** If no immediate threat or scoring opportunity exists, it maintains control via dribble.

## 5. Agent Behavior Cycle

The simulation executes a continuous loop consisting of:

1. **Perception:** Sensing the environment state.
2. **Update:** Integrating perceptions into the internal World Model.
3. **Deliberation:** Using the Decision-Making Module to select a rational action.
4. **Execution:** Acting upon the environment.
5. **Learning/Feedback:** Updating the performance score to reflect the utility of the chosen action.
6. **Transition:** The environment transitions to a new state for the next time step.

## 6. Simulation Results & Analysis

The execution results demonstrate that the agent acts **rationally**: it does not shoot from long distances and prioritizes ball acquisition when necessary. The final performance score serves as a metric for the agent's efficiency within the 10-step simulation window.

## 7. Conclusion

This individual project successfully implements the fundamental concepts of Artificial Intelligence. By using the PEAS framework, I have demonstrated how an autonomous agent can be designed to handle dynamic environments. This work provides a foundation for more advanced AI techniques, such as **Reinforcement Learning** (where the agent learns the thresholds itself) or **Multi-Agent Systems** (where multiple agents coordinate to achieve a shared goal).

**Project End**