Road to Intelligence: The Agent's Race

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Game Description:

The game simulates two intelligent buses competing on a 2000 km track. Each bus operates as an intelligent agent, using sensors and actuators to perceive the environment, avoid obstacles, and interact with its opponent. The environment is dynamic, partially observable, and may involve uncertain outcomes. The game integrates key AI concepts such as adversarial search, A* search, fuzzy logic, and probabilistic reasoning to model real-world decision-making under uncertainty.

Game Rules:

- **Agent Characteristics:**
  - **Bus A:** Goal-based agent aiming to reach 2000 km and push the opponent off the track.
  - **Bus B:** Adversarial agent aiming to reach 2000 km and push the opponent off the track.
- **Environment:**
  - Partially observable and dynamic.
  - Obstacles appear on the road that must be avoided while maintaining progress.
- **Winning Condition:**
  - A bus wins if:
    - It reaches 2000 km first while staying on the road.
    - It successfully pushes the opponent off the track.

Problem Solving & Search:

Each bus uses various search strategies to navigate the track, avoid obstacles, and compete with the opponent:

- **Uninformed Search:**
  - **Breadth-First Search (BFS):** Used for safe pathfinding.
  - **Depth-First Search (DFS):** Used for risky shortcuts.
- **Informed Search:**
  - *A Search:** Optimizes pathfinding by using heuristics for the fastest and safest route.
- **Adversarial Search:**
  - Models the behavior of the opponent to create game-playing strategies.
- **Obstacle Representation:**
  - Obstacles represent toy problems that require solving.
  - Opponent actions are treated as adversarial challenges.

Game Playing Strategy:

- Modeled as a two-player adversarial game:
  - **Bus A:** Focuses on avoiding obstacles, pushing Bus B off the road, and reaching 2000 km.
  - **Bus B:** Focuses on avoiding obstacles, pushing Bus A off the road, and reaching 2000 km.

- **Alpha-Beta Pruning:** Used for optimizing moves and decision-making.
- **Uncertainty Handling:** Probabilistic reasoning is applied to manage uncertainty in the environment.

Knowledge & Reasoning:

- Both buses act as knowledge-based agents using rules and logical reasoning:
  - **Example Rule:** "If an obstacle is ahead within 20 meters, apply brakes."
  - **First-Order Logic:** Represents relationships, such as "Bus X is near Bus Y."
- **Inference Methods:**
  - **Forward Chaining:** Used for immediate decision-making.
  - **Backward Chaining:** Used for predicting opponent actions.

Uncertain Knowledge & Probabilistic Reasoning:

- The environment involves randomness and uncertainty:
  - **Bayesian Probability:** Handles random obstacle appearances.
  - **Probability Rules:** Aid in decisions like whether to accelerate or slow down.
  - **Fuzzy Logic:** Handles vague situations, such as when a bus is "nearly outside the road."

Planning & Acting:

Each bus uses a planner to cover the 2000 km, with the ability to replan if blocked or forced off course:

- **Actions:**
  - Speed up, brake, dodge, avoid obstacles, or push the opponent.
- **STRIPS-like Representation:**
  - **Initial State:** Both buses start at the start line.
  - **Goal State:** Either reach 2000 km or push the opponent off the track.