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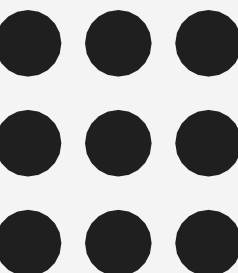
Department of AI &DS

Course Name – 19AD602 DEEP LEARNING

III Year / VI Semester

UNIT-4 OPTIMIZATION AND GENERALIZATION

Topic: Deep Reinforcement Learning

CASE STUDY:

Deep Reinforcement Learning (DRL) in Autonomous Driving

A research team developed a DRL-based self-driving car model using Deep Q-Networks (DQN) to navigate urban environments. The model was trained in a simulated environment with reward-based learning, enabling it to handle obstacles, traffic signals, and dynamic road conditions. After extensive testing, the DRL-powered vehicle achieved a 20% improvement in safety and efficiency compared to traditional rule-based systems.

- Deep Reinforcement Learning (DRL) is a revolutionary Artificial Intelligence methodology that combines <u>reinforcement learning</u> and <u>deep neural networks</u>.
- By iteratively interacting with an environment and making choices that maximise cumulative rewards, it enables agents to learn sophisticated strategies.
- Agents are able to directly learn rules from sensory inputs thanks to DRL, which makes use of deep learning's ability to extract complex features from unstructured data.
- DRL relies heavily on <u>Q-learning</u>, policy gradient methods, and <u>actor-critic systems</u>.
- The notions of value networks, policy networks, and exploration-exploitation trade-offs are crucial.

- The uses for DRL are numerous and include <u>robotics</u>, gaming, banking, and healthcare.
- Its development from Atari games to real-world difficulties emphasises how versatile and potent it is.
- Sample effectiveness, exploratory tactics, and safety considerations are difficulties.
- The collaboration aims to drive DRL responsibly, promising an inventive future that will change how decisions are made and problems are solved.

CORE CONCEPTS:

Deep Reinforcement Learning (DRL) building blocks include all the aspects that power learning and empower agents to make wise judgements in their surroundings. Effective learning frameworks are produced by the cooperative interactions of these elements. The following are the essential elements:

- **Agent**: The decision-maker or learner who engages with the environment. The agent acts in accordance with its policy and gains experience over time to improve its ability to make decisions.

- **Environment**: The system outside of the agent that it communicates with. Based on the actions the agent does, it gives the agent feedback in the form of incentives or punishments.

- **State**: A depiction of the current circumstance or environmental state at a certain moment. The agent chooses its activities and makes decisions based on the state.

- **Action**: A choice the agent makes that causes a change in the state of the system. The policy of the agent guides the selection of actions.Reward: A scalar feedback signal from the environment that shows whether an agent's behaviour in a specific state is desirable. The agent is guided by rewards to learn positive behaviour.

- **Policy**: A plan that directs the agent's decision-making by mapping states to actions. Finding an ideal policy that maximises cumulative rewards is the objective.

  - **Value Function**: This function calculates the anticipated cumulative reward an agent can obtain from a specific state while adhering to a specific policy. It is beneficial in assessing and contrasting states and policies.

  - **Model**: A depiction of the dynamics of the environment that enables the agent to simulate potential results of actions and states. Models are useful for planning and forecasting.

  - **Exploration-Exploitation Strategy**: A method of making decisions that strikes a balance between exploring new actions to learn more and exploiting well-known acts to reap immediate benefits (exploitation).

  - **Learning Algorithm:** The process by which the agent modifies its value function or policy in response to experiences gained from interacting with the environment. Learning in DRL is fueled by a variety of algorithms, including Q-learning, policy gradient, and actor-critic.

  - **Deep Neural Networks:** DRL can handle high-dimensional state and action spaces by acting as function approximators in deep neural networks. They pick up intricate input-to-output mappings.

  - **Experience Replay:** A method that randomly selects from stored prior experiences (state, action, reward, and next state) during training. As a result, learning stability is improved and the association between subsequent events is decreased.

In Deep Reinforcement Learning (DRL), an agent interacts with an environment to learn how to make optimal decisions.

Steps:

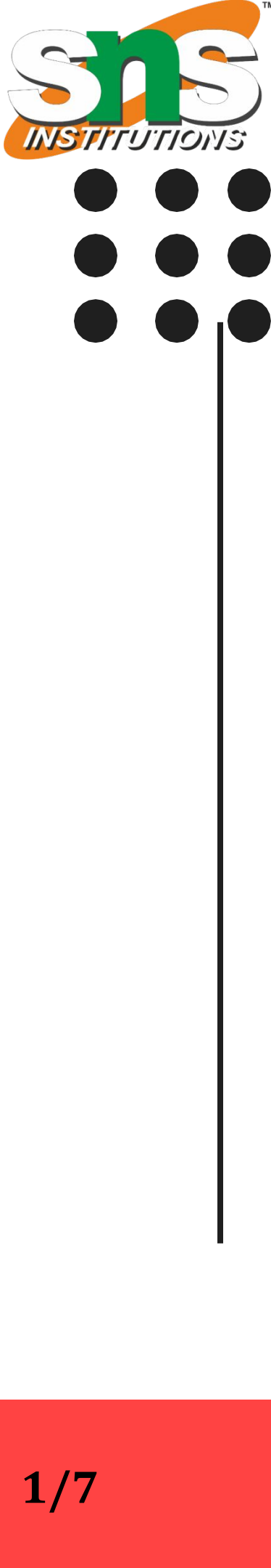Initialization: Construct an agent and set up the issue.

Interaction: The agent interacts with its surroundings through acting, which results in states and rewards.

Learning: The agent keeps track of its experiences and updates its method for making decisions

Policy Update: Based on data, algorithms modify the agent's approach.

Exploration-Exploitation: The agent strikes a balance between using well-known actions and trying out new ones.

Reward Maximization: The agent learns to select activities that will yield the greatest possible total rewards.

Convergence: The agent's policy becomes better and stays the same over time.

Extrapolation: Skilled agents can use what they've learned in fresh circumstances.
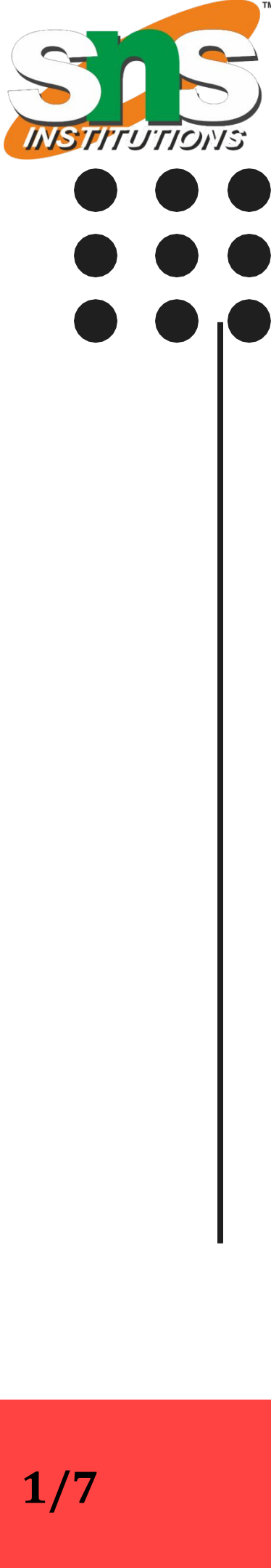
Evaluation: Unknown surroundings are used to assess the agent's performance.

Use of the trained agent in practical situations.

APPLICATIONS:

- ROBOTICS

- FINANCE

- HEALTH CARE ETC..,

THANK YOU