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# Simplified TensorFlow with Gym for Google Colab - Faster Version
# May 2025

import tensorflow as tf
import gymnasium as gym
import numpy as np
import matplotlib.pyplot as plt

# Install required packages (uncomment if needed)
# !pip install gymnasium

# Create environment
env = gym.make('CartPole-v1')
state_size = env.observation_space.shape[0]  # 4 values: position,
velocity, angle, angular velocity
action_size = env.action_space.n             # 2 actions: move left or
right

# Build a smaller model
model = tf.keras.Sequential([
    tf.keras.layers.Dense(12, input_dim=state_size,
activation='relu'),
    tf.keras.layers.Dense(action_size, activation='linear')
])
model.compile(loss='mse',
optimizer=tf.keras.optimizers.Adam(learning_rate=0.001))
model.summary()

# Training parameters - REDUCED FOR SPEED
epsilon = 1.0         # Exploration rate
epsilon_decay = 0.9   # Faster decay
epsilon_min = 0.1
gamma = 0.95          # Discount factor
memory = []
batch_size = 16       # Smaller batch
episodes = 10         # Fewer episodes

# Track scores for plotting
scores = []

# Training loop
for episode in range(episodes):
    # Reset environment
    state, _ = env.reset()
    state = np.reshape(state, [1, state_size])
    done = False
    score = 0

    # Limit steps per episode for speed
    max_steps = 200
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    for step in range(max_steps):
        # Choose action: explore or exploit
        if np.random.rand() <= epsilon:
            action = env.action_space.sample()  # Explore
        else:
            action_values = model.predict(state, verbose=0)
            action = np.argmax(action_values[0])  # Exploit

        # Take action
        next_state, reward, terminated, truncated, _ =
env.step(action)
        done = terminated or truncated
        next_state = np.reshape(next_state, [1, state_size])
        score += reward

        # Store experience
        memory.append((state, action, reward, next_state, done))
        state = next_state

        # Train model - only train every 4 steps for speed
        if len(memory) > batch_size and step % 4 == 0:
            # Sample random batch from memory
            batch = np.random.choice(len(memory), batch_size,
replace=False)
            for i in batch:
                s, a, r, next_s, d = memory[i]
                # Q-learning formula
                target = r
                if not d:
                    target = r + gamma * np.amax(model.predict(next_s,
verbose=0)[0])

                target_f = model.predict(s, verbose=0)
                target_f[0][a] = target

                # Train network with a single sample
                model.fit(s, target_f, epochs=1, verbose=0)

        if done:
            break

    # Reduce exploration faster
    epsilon = max(epsilon_min, epsilon * epsilon_decay)

    scores.append(score)
    print(f"Episode: {episode+1}/{episodes}, Score: {score}, Epsilon:
{epsilon:.2f}")

# Plot results
plt.figure(figsize=(8, 4))
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plt.plot(scores)
plt.title('Training Progress')
plt.xlabel('Episodes')
plt.ylabel('Score')
plt.grid(True)
plt.show()

# Quick test of trained model
print("\nTesting trained model...")
state, _ = env.reset()
state = np.reshape(state, [1, state_size])
done = False
score = 0
for _ in range(200):  # Limit test steps
    action_values = model.predict(state, verbose=0)
    action = np.argmax(action_values[0])
    next_state, reward, terminated, truncated, _ = env.step(action)
    done = terminated or truncated
    state = np.reshape(next_state, [1, state_size])
    score += reward
    if done:
        break

print(f"Test score: {score}")
env.close()
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Model: "sequential_3"
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┃ Layer (type)                    ┃ Output Shape           ┃       Param # ┃
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│ dense_12 (Dense)                │ (None, 12)             │            60 │
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│ dense_13 (Dense)                │ (None, 2)              │            26 │
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 Total params: 86 (344.00 B)

 Trainable params: 86 (344.00 B)

 Non-trainable params: 0 (0.00 B)
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Episode: 1/10, Score: 15.0, Epsilon: 0.90
Episode: 2/10, Score: 10.0, Epsilon: 0.81
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Episode: 3/10, Score: 20.0, Epsilon: 0.73
Episode: 4/10, Score: 25.0, Epsilon: 0.66
Episode: 5/10, Score: 14.0, Epsilon: 0.59
Episode: 6/10, Score: 9.0, Epsilon: 0.53
Episode: 7/10, Score: 12.0, Epsilon: 0.48
Episode: 8/10, Score: 8.0, Epsilon: 0.43
Episode: 9/10, Score: 12.0, Epsilon: 0.39
Episode: 10/10, Score: 13.0, Epsilon: 0.35
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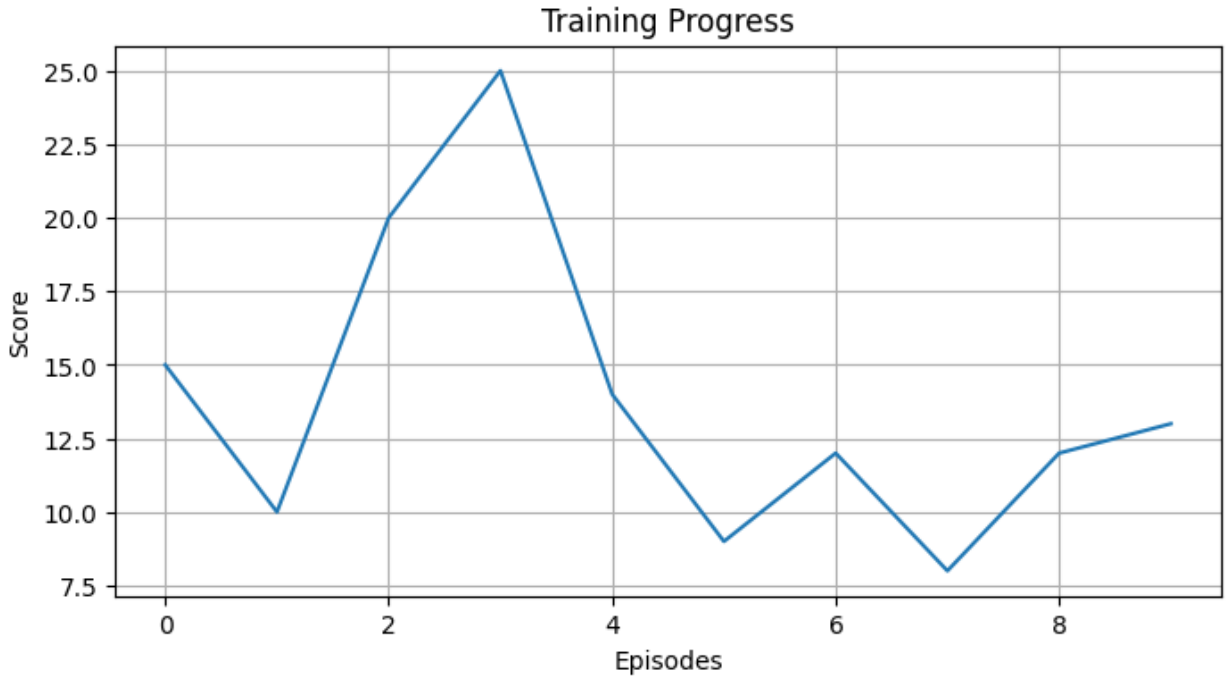


```
Testing trained model...
Test score: 10.0
```