Optimized Kalman Filter

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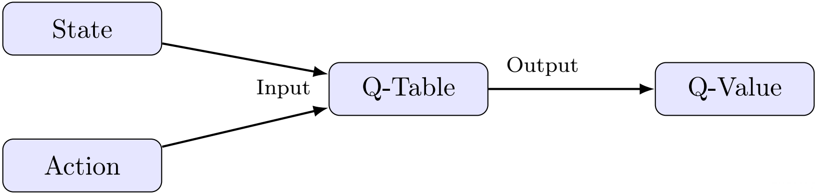
Epsilon-Greedy Policy

- **Q-table:** Internally, Q-Learning uses a Q-table storing values for each state-action pair. Initially, all values are zero, and the table is updated iteratively during training.

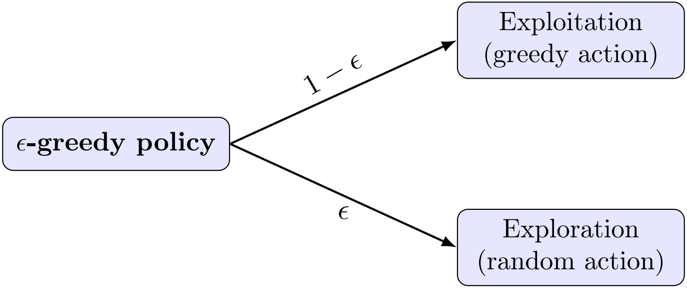
$$Q(s_t, a_t) \leftarrow Q(s_t, a_t) + \alpha \left[r_{t+1} + \gamma \max_a Q(s_{t+1}, a) - Q(s_t, a_t) \right]$$



Epsilon-Greedy Policy

- **Epsilon-Greedy Strategy :** To balance exploration and exploitation, actions are chosen using an epsilon-greedy policy

$$\pi^*(s) = \arg\max_a Q^*(s, a)$$



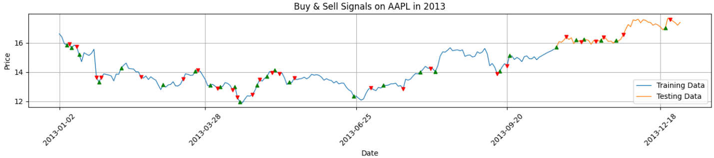
Environement Implementation

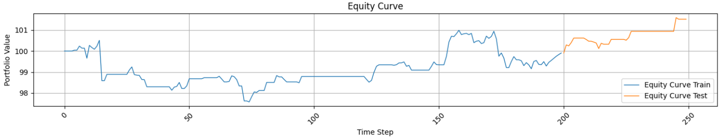
TradingEnv
- df : DataFrame - n_steps : int - current_step : int - initial_balance : float - balance : float - position : int - last_action : int - observation_space : Box - action_space : Discrete
+ __init__(df) + _get_obs() + sample_valid_action() + get_valid_actions() + step(action) + set_data(df) + reset()

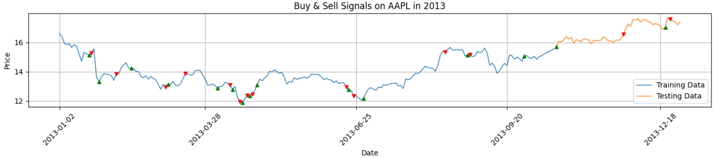
Algorithm 1: Trading Environment Behavior

```
Input: Environment env, number of episodes N,
       exploration rate ε
Output: Episode value and rewards
for episode ← 1 to N
    s ← env.reset();
    total_reward ← 0;
    while True
        Get valid actions
          A_valid ← env.get_valid_actions();
        Select a ← random choice from A_valid;
        Execute
          (s', r, done, info) ← env.step(a);
        total_reward ← total_reward +r;
        Log
          (episode, s, a, r, info["portfolio_value"]);

        s ← s';
        if done then
            break

    Print episode summary : total_reward, final
      portfolio value;
```

Results


Buy & Sell Signals on AAPL in 2013
Price
16
14
12
2013-01-02
2013-03-28
2013-06-25
2013-09-20
2013-12-18
Date
Training Data
Testing Data


Equity Curve
Portfolio Value
101
100
99
98
0
50
100
150
200
250
Time Step
Equity Curve Train
Equity Curve Test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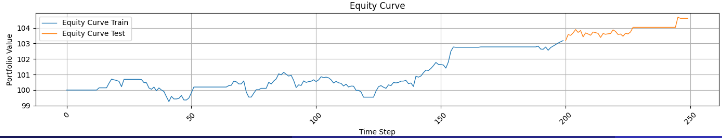
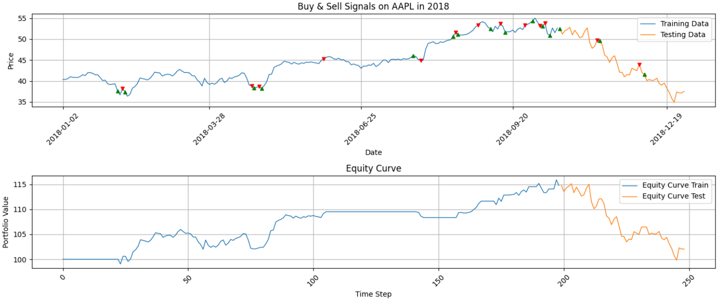
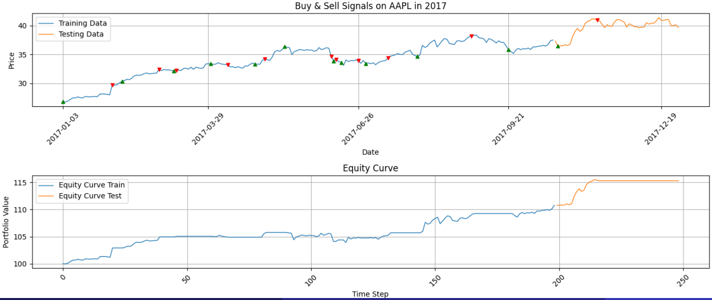

Equity Curve
Portfolio Value
104
103
102
101
100
99
0
50
100
150
200
250
Time Step
Equity Curve Train
Equity Curve Test

Results issues





Preparing PPO

- Designing and integrating a deep neural network architecture
- Compare DQN and Q-Learning greedy policy
- Expanding to more realistic market conditions
- Hyperparameterization

Thank You