Research on Online Game Design Based on Artificial Intelligence Algorithm

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1 INTRODUCTION

- background

  In today's game industry, AI has become a widely used technology.

  Use and improvement of AI technology can further strengthen the role expression and environmental authenticity in the game, making the NPC in the game more intelligent and human.

1 INTRODUCTION

- Aim

  This paper describes the concrete design and detailed implementation of the optimized behavior decision system, and designs the overall architecture of the AI engine.

2.METHOD

Game AI Behavior Decision-Making Design

The behavior decision-making system of a game character is the key factor of weather a character can be intelligent.

It needs to be able to analyze the various situations of the role itself and the game environment in which the role is located, and make a reasonable response to it.

2.METHOD

Game AI Behavior Decision-Making Design

Deep reinforcement learning

Difference from traditional Q-learning

- The deep convolution network+fully connected network is used as the approximation function.

- The sample is stored in the experience pool.

- The target network is used to get the TD-target separately.

2.METHOD

Game AI Behavior Decision-Making Design

The genetic SASarsa algorithm

The genetic SASarsa algorithm takes the value of exploration rate as the solution of chromosomes in the genetic process and also represents the state in the annealing process.

2.METHOD

Game AI Behavior Decision-Making Design

The iterative formula of the state action pair value of Sarsa algorithm

$$Q\left(s_t, a_t\right) = Q\left(s_t, a_t\right) + \alpha\left(r_t + \gamma Q\left(s_{t+1}, a_{t+1}\right) - Q\left(s_t, a_t\right)\right)$$

Gamma: discount factor   St: state of the Agent at the current time t

After performing an action at, the Agent enters the next time t+1 and recieves ab immediate return rt, and enters the state st+1 and Q(st+1,at+1), Q(st,at), both of which are the values of state action pairs.

2.METHOD

Game AI Behavior Decision-Making Design

GA(Genetic Algorithm) and SA(Simulated Algorithm)

GA: Poor local search ability and strong ability to grasp the overall search process.

SA: Strong local search ability and can prevent the search process from falling into the local optimal solution.

2.METHOD

Game AI Behavior Decision-Making Design

Let the optimization room of nonlinear function be entitled as the following minimization problem.

$$\min f(x)$$
$$a(j) \leq x(j) \leq b(j) \qquad j = 1, 2, \cdots, p$$

x = {x(j)}: the set of optimization variables
[a(j),b(j)]: the change interval of x(j)
p: the number of optimization variables
f: the objective function

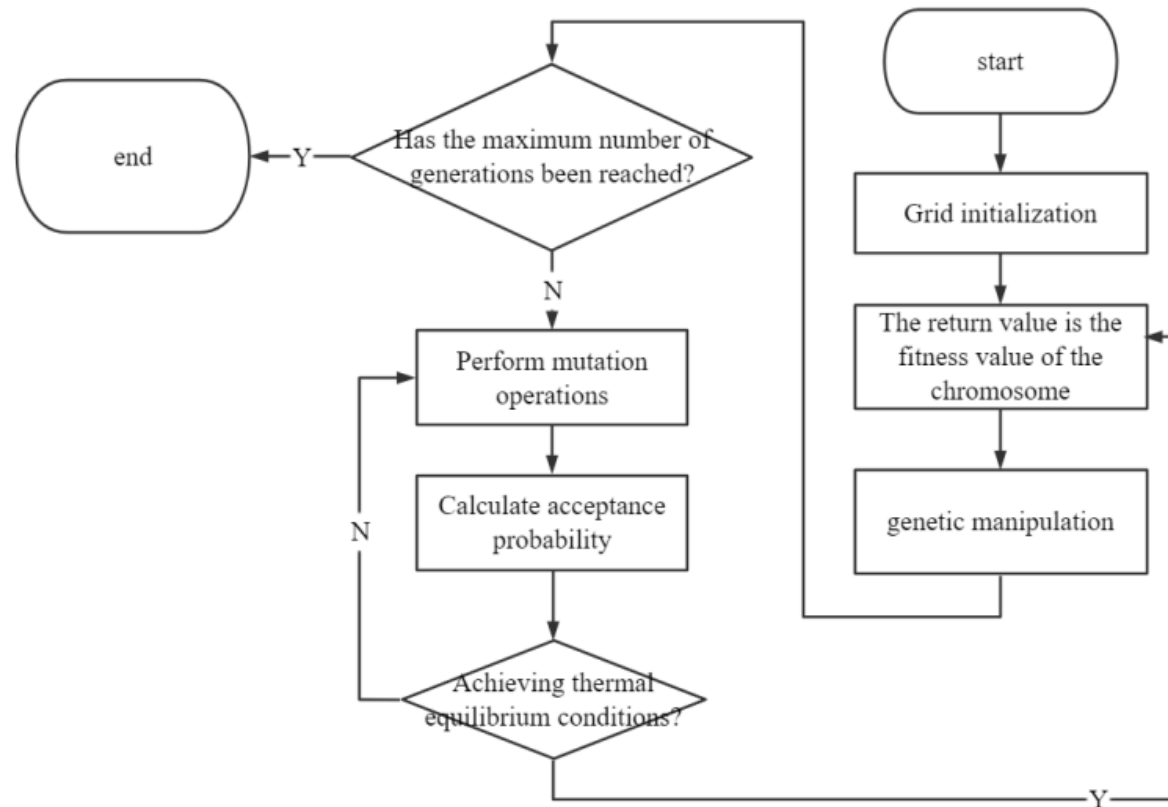# 2.METHOD

Game AI Behavior Decision-Making Design

Figure 1: Algorithm training process

2.METHOD

Design of Game AI Engine

Decision-making part of AI is designed by game planners, and the logic of each game is completely different.

Game AI Engine of this paper only provides a logical implementation mechanism and a path-finding algorithm with high universality.

2.METHOD

Design of Game AI Engine

AI needs to coordinate data calculation in the background and animation display in the foreground.

It introduces multithreading mechanism and design pattern of producers and consumers, and uses near-end strategy optimization algorithm to improve search efficiency

2.METHOD

Design of Game AI Engine

The near-end strategy optimization algorithm

according to the principle of importance sampling

$$J^{\theta^k} = E_{s_t, a_t \sim \pi_{\theta^k}} \left[\frac{P_\theta\left(a_t \,|s_t\right)}{P_{\theta^k}\left(a_t \,|s_t\right)} A^{\theta^k} s_t, a_t \right]$$

$\Theta(at|st)$: transition probability of the policy currently being updated
Θ^k: the parameter of the policy network used for interaction

2.METHOD

Design of Game AI Engine

Introduce KL divergence into the objective function

$$J_{PPO}^{\theta^k}\theta = J^{\theta^k}\theta - \beta KLP_{\theta^k}\left|s_t, P_\theta\right|s_t$$

Beta is used to adjust the constraint strength of KL divergence and ensure it to play a moderate role.
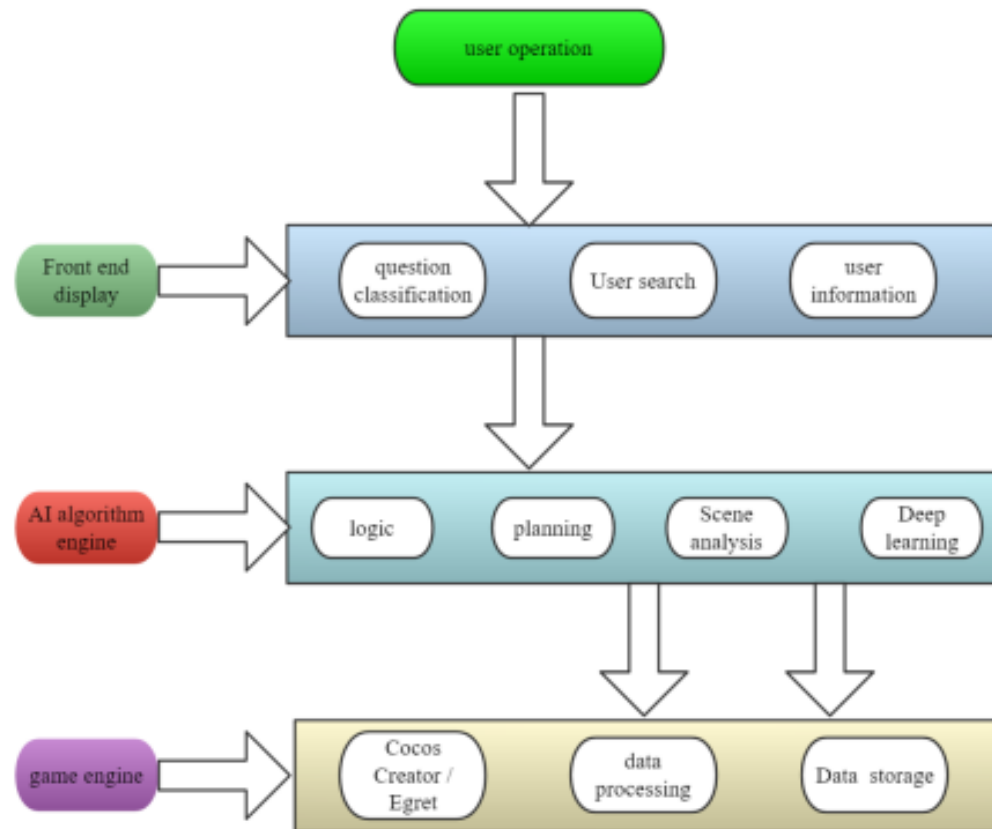
2.METHOD

Design of Game AI Engine

Figure 2: Structural design of game AI engine

3.RESULT

This section carries out experiments on the AI algorithm designed in the previous section.

Two different game characters, hunters and prey, are defined and move in the experimental game scene with different behavior patterns.

3.RESULT

In this experiment, the damage is directly reflected in the health value of the intelligent agent.
The initial health value is 100 points, and each point of damage is reduced by 1 point. When the health value is 0, death is declared.

Both prey and hunter can use skills and two types of skills exist: control skill and displacement skill(Not explained in detail of these skills).
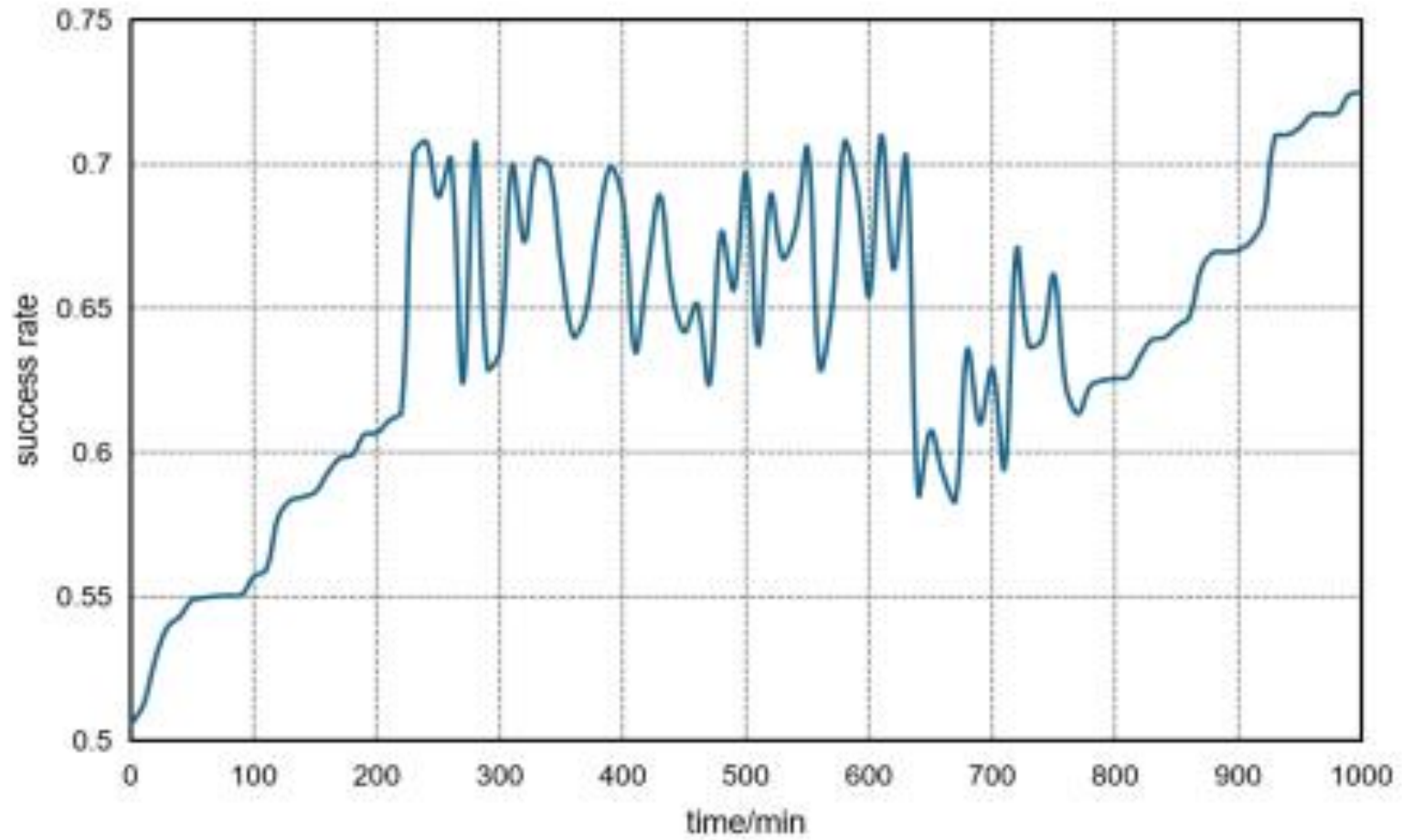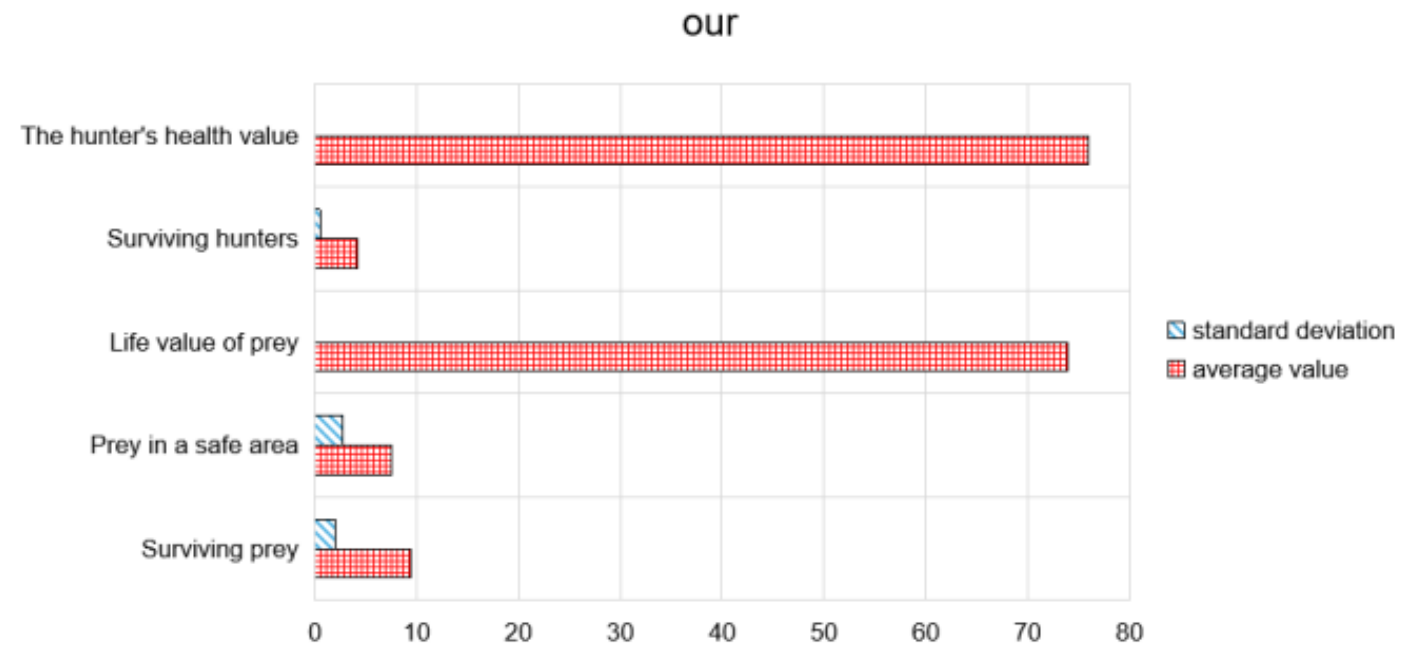
3.RESULT

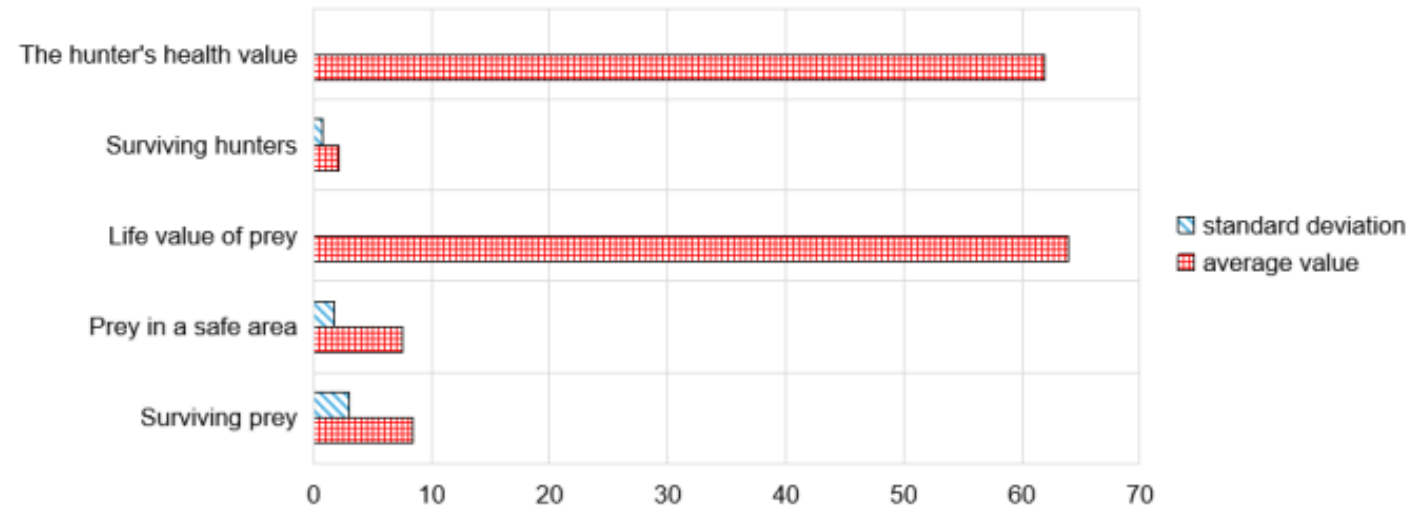**Figure 3: Game AI training results**

3.RESULT

Figure 4: Simulation experiment results

3.RESULT

This experiment shows that the strategy method based on AI in this paper can better guide the behavior of prey and improve the survivability of prey characters.

4.CONCLUSION

Experiments show that reinforcement learning method can use the same reward function for similar intelligent agents, so as to achieve action decisions that conform to the game world view and set after training.

It can complete the construction of game AI without reorganizing the decision structure, and improve the intelligence level of intelligent agents in the game.

Thank you for your attention!