KNOWNSEC

Degree of secrecy ★ | Project team open

Smart Contract Audit Report

Security status

Safe

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Principal tester: Knownsec blockchain security team

Version Summary

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Report Information

Title	Version	Document Number	Type
GFC Smart Contract Audit Report	V1.0	b09552f1316e4cbda7ec446fa795e5aa	Open to project team

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1. Introduction

The effective test time of this report is from From March 13, 2021 to March 15, 2021 . During this period, the security and standardization of the smart contract code of the GFC will be audited and used as the statistical basis for the report.

The scope of this smart contract security audit does not include external contract calls, new types of attacks that may appear in the future, and code after contract upgrades or tampering. (With the development of the project, the smart contract may add a new pool , New functional modules, new external contract calls, etc.), does not include front-end security and server security.

In this audit report, engineers conducted a comprehensive analysis of the common vulnerabilities of smart contracts (Chapter 3). **The smart contract code of the GFC** is comprehensively assessed as **SAFE**.

Results of this smart contract security audit： SAFE

Since the testing is under non-production environment, all codes are the latest version. In addition, the testing process is communicated with the relevant engineer, and testing operations are carried out under the controllable operational risk to avoid production during the testing process, such as: Operational risk, code security risk.

Report information of this audit:

Report Number：b09552f1316e4cbda7ec446fa795e5aa

Report query address link:

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Target information of the GFC audit:

Target information	
Token name	GFC
Code type	Token code, DeFi protocol code, BSC smart contract code
Code language	solidity

Contract documents and hash:

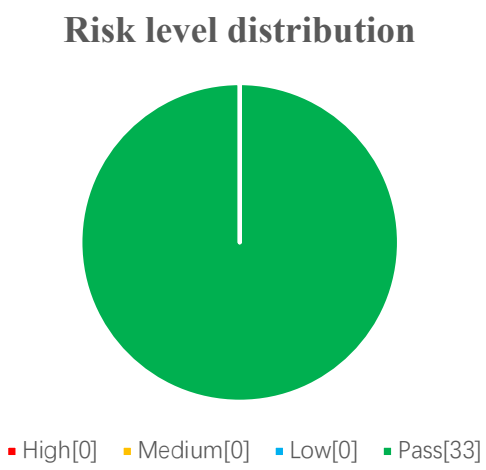
Contract documents	MD5
GalaxyReward.sol	d07582d898f1c063f35122b3dcf812ae
GFV.sol	7fb2c3b72b67e2e60998114abfa4980e
SegmentPowerStrategy.sol	66649502e1b386f2ece1208ade1e3f9d

2. Code vulnerability analysis

2.1 Vulnerability Level Distribution

Vulnerability risk statistics by level：

Vulnerability risk level statistics table			
High	Medium	Low	Pass
0	0	0	33



2.2 Audit Result

Result of audit			
Audit Target	**Audit**	**Status**	**Audit Description**
Business security testing	**LPTokenWrapper contract pledge function**	Pass	After testing, there is no such safety vulnerability.
	LPTokenWrapper contract withdrawal function	Pass	After testing, there is no such safety vulnerability.
	GalaxyReward contract obtains transaction pair price function	Pass	After testing, there is no such safety vulnerability.
	SegmentPowerStrategy contract liquidity inflow function	Pass	After testing, there is no such safety vulnerability.
	SegmentPowerStrategy contract liquidity outflow function	Pass	After testing, there is no such safety vulnerability.
	SegmentPowerStrategy contract liquidity outflow function	Pass	After testing, there is no such safety vulnerability.
Basic code vulnerability detection	**Compiler version security**	Pass	After testing, there is no such safety vulnerability.
	Redundant code	Pass	After testing, there is no such safety vulnerability.
	Use of safe arithmetic library	Pass	After testing, there is no such safety vulnerability.
	Not recommended encoding	Pass	After testing, there is no such safety vulnerability.

	Reasonable use of require/assert	Pass	After testing, there is no such safety vulnerability.
	fallback function safety	Pass	After testing, there is no such safety vulnerability.
	tx.oriigin authentication	Pass	After testing, there is no such safety vulnerability.
	Owner permission control	Pass	After testing, there is no such safety vulnerability.
	Gas consumption detection	Pass	After testing, there is no such safety vulnerability.
	call injection attack	Pass	After testing, there is no such safety vulnerability.
	Low-level function safety	Pass	After testing, there is no such safety vulnerability.
	Vulnerability of additional token issuance	Pass	After testing, there is no such safety vulnerability.
	Access control defect detection	Pass	After testing, there is no such safety vulnerability.
	Numerical overflow detection	Pass	After testing, there is no such safety vulnerability.
	Arithmetic accuracy error	Pass	After testing, there is no such safety vulnerability.
	Wrong use of random number detection	Pass	After testing, there is no such safety vulnerability.
	Unsafe interface use	Pass	After testing, there is no such safety vulnerability.
	Variable coverage	Pass	After testing, there is no such safety vulnerability.

	Uninitialized storage pointer	Pass	After testing, there is no such safety vulnerability.
	Return value call verification	Pass	After testing, there is no such safety vulnerability.
	Transaction order dependency detection	Pass	After testing, there is no such safety vulnerability.
	Timestamp dependent attack	Pass	After testing, there is no such safety vulnerability.
	Denial of service attack detection	Pass	After testing, there is no such safety vulnerability.
	Fake recharge vulnerability detection	Pass	After testing, there is no such safety vulnerability.
	Reentry attack detection	Pass	After testing, there is no such safety vulnerability.
	Replay attack detection	Pass	After testing, there is no such safety vulnerability.
	Rearrangement attack detection	Pass	After testing, there is no such safety vulnerability.

3. Analysis of code audit results

3.1. LPTokenWrapper contract pledge function【PASS】

Audit analysis: The pledge function of the LPTokenWrapper contract is implemented by the stake function of the GalaxyReward.sol contract file, which is used for users to pledge and update the power value.

```
function stake(uint256 amount) public virtual { //knownsec// Pledge
        _totalSupply = _totalSupply.add(amount); //knownsec// It is recommended to judge that the amount of pledge is greater than 0
        _balances[msg.sender] = _balances[msg.sender].add(amount);

        if( _powerStrategy != address(0)){ //knownsec// _powerStrategy 存在
            _totalPower = _totalPower.sub(_powerBalances[msg.sender]);
            IPowerStrategy(_powerStrategy).lpIn(msg.sender, amount);

            _powerBalances[msg.sender] = IPowerStrategy(_powerStrategy).getPower(msg.sender); //knownsec// Deposit amount to obtain new balances of user power
            _totalPower = _totalPower.add(_powerBalances[msg.sender]);
        }else{ //knownsec// If it does not exist, set the current value to the initial value
            _totalPower = _totalSupply;
            _powerBalances[msg.sender] = _balances[msg.sender];
        }

        _lpToken.safeTransferFrom(msg.sender, address(this), amount);
    }
```

Recommendation： nothing.

3.2. LPTokenWrapper contract withdrawal function【PASS】

Audit analysis: The withdrawal function of the LPTokenWrapper contract is implemented by the withdraw function of the GalaxyReward.sol contract file, which is used for users to withdraw and update the power value.

```
    function withdraw(uint256 amount) public virtual{ //knownsec// withdraw
        require(amount > 0, "amout > 0"); //knownec// The amount of withdrawal must be greater than 0

        _totalSupply = _totalSupply.sub(amount);
        _balances[msg.sender] = _balances[msg.sender].sub(amount);

        if( _powerStrategy != address(0x0)){ //knownsec// _powerStrategy 存在
            _totalPower = _totalPower.sub(_powerBalances[msg.sender]);
            IPowerStrategy(_powerStrategy).lpOut(msg.sender, amount);
            _powerBalances[msg.sender] = IPowerStrategy(_powerStrategy).getPower(msg.sender); //knownsec// Take out amount to obtain new balances of user power
            _totalPower = _totalPower.add(_powerBalances[msg.sender]);

        }else{ //knownsec// If it does not exist, set the current value to the initial value
            _totalPower = _totalSupply;
            _powerBalances[msg.sender] = _balances[msg.sender];
        }

        _lpToken.safeTransfer( msg.sender, amount);
    }
```

Recommendation： nothing.

3.3. GalaxyReward contract obtains transaction pair price function【PASS】

Audit analysis: The function of obtaining the transaction pair price of the GalaxyReward contract is implemented by the getPairPrice function of the GalaxyReward.sol contract file, which is used to obtain the price of the token0 and token1 transaction pair.

```
function getPairPrice(address token0,address token1) public view returns (uint256) {
        IPancakeFactory factory = IPancakeFactory(pancakeFactory);
        address pairAddress = factory.getPair(token0,token1);
        if(pairAddress == address (0x0)) { //knownsec// The transaction pair address is 0 indicating that the transaction pair does not exist
            return 0;
        }

        IPancakePair pair = IPancakePair(pairAddress);
        (uint112 _reserve0, uint112 _reserve1,) = pair.getReserves();
        (uint256 value0,uint256 value1) = token0 == pair.token0() ? (uint256(_reserve0),uint256(_reserve1)) : (uint256(_reserve1),uint256(_reserve0));
        uint256 decimals0 = uint256(ERC20(token0).decimals());
        uint256 decimals1 = uint256(ERC20(token1).decimals());

        return uint256(10**18).mul(uint256(10 ** decimals1)).mul(value0).div(value1).div(uint256(10** decimals0)) ;
    }
```

Recommendation： nothing.

3.4. SegmentPowerStrategy contract liquidity inflow function【PASS】

Audit analysis: The liquidity inflow function of the SegmentPowerStrategy contract is implemented by the lpIn function of the SegmentPowerStrategy.sol contract file, which is used to increase the number of user pledges and add new user pledge information.

```
function lpIn(address sender, uint256 amount)
    isNormalPool()
    external {

        uint32 playerId = _addressXId[sender];
        if ( playerId > 0 ) {
            _playerMap[playerId].amount = _playerMap[playerId].amount.add(amount);
        } else {
            //new addr
            _playerId = _playerId+1;
            _addressXId[sender] = _playerId;

            playerId = _playerId;
            _playerMap[playerId].playerId = playerId;
            _playerMap[playerId].amount = amount;
            _playerMap[playerId].segIndex = 0;
            _playerMap[playerId].offset =  0;

            //update segment
            updateSegment();
        }

        settlePowerData(playerId);
    }
```

Recommendation： nothing.

3.5. SegmentPowerStrategy contract liquidity outflow function【PASS】

Audit analysis: The liquidity outflow function of the SegmentPowerStrategy contract is implemented by the lpOut function of the SegmentPowerStrategy.sol contract file, which is used to update and reduce the amount of user pledge.

```
function lpOut(address sender, uint256 amount)
    isNormalPool()
    external{
        uint32 playerId = _addressXId[sender];
        if ( playerId > 0 ) { //knownsec// The user's information does not exist in the pool, and it is not allowed to take it out
            _playerMap[playerId].amount = _playerMap[playerId].amount.sub(amount);
        } else {
            return;
        }

        settlePowerData(playerId);
    }
```

Recommendation： nothing.

3.6. SegmentPowerStrategy contract data exchange function【PASS】

Audit analysis: The data exchange function of the SegmentPowerStrategy contract is implemented by the segmentSwap function of the SegmentPowerStrategy.sol contract file, which is used to exchange player data from the old segment to the new segment.

```
    function segmentSwap(uint32 playerId, uint8 segIndex) internal {
```

```
        uint8 oldSegIndex = _playerMap[playerId].segIndex;

        uint32 oldOffset = _playerMap[playerId].offset;
        uint32 tail = _countSegment[segIndex].curCount;

        _playerMap[playerId].segIndex = segIndex;
        _playerMap[playerId].offset = tail;

        _countSegment[segIndex].curCount = _countSegment[segIndex].curCount+1;
        _playerIds[segIndex][tail] = playerId;

        if (oldSegIndex>0 && segIndex != oldSegIndex && _playerIds[oldSegIndex][oldOffset] > 0) {

            uint32 originTail = _countSegment[oldSegIndex].curCount-1;
            uint32 originTailPlayer = _playerIds[oldSegIndex][originTail];

            if(originTailPlayer != playerId){

                _playerMap[originTailPlayer].segIndex = oldSegIndex;
                _playerMap[originTailPlayer].offset = oldOffset;
                _playerIds[oldSegIndex][oldOffset] = originTailPlayer;
            }

            _playerIds[oldSegIndex][originTail] = 0;
            _countSegment[oldSegIndex].curCount = _countSegment[oldSegIndex].curCount-1;
        }
    }
```

Recommendation： nothing.

4. Basic code vulnerability detection

4.1. Compiler version security【PASS】

Check whether a safe compiler version is used in the contract code implementation.

Audit result: After testing, the smart contract code has formulated the compiler version 0.6.0 within the major version, and there is no such security problem.

Recommendation： nothing.

4.2. Redundant code【PASS】

Check whether the contract code implementation contains redundant code.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.3. Use of safe arithmetic library【PASS】

Check whether the SafeMath safe arithmetic library is used in the contract code implementation.

Audit result: After testing, the SafeMath safe arithmetic library has been used in the smart contract code, and there is no such security problem.

Recommendation： nothing.

4.4. Not recommended encoding【PASS】

Check whether there is an encoding method that is not officially recommended or abandoned in the contract code implementation

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.5. Reasonable use of require/assert【PASS】

Check the rationality of the use of require and assert statements in the contract code implementation.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.6. Fallback function safety【PASS】

Check whether the fallback function is used correctly in the contract code implementation.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.7. tx.origin authentication【PASS】

tx.origin is a global variable of Solidity that traverses the entire call stack and returns the address of the account that originally sent the call (or transaction). Using this variable for authentication in a smart contract makes the contract vulnerable to attacks like phishing.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.8. Owner permission control【PASS】

Check whether the owner in the contract code implementation has excessive authority. For example, arbitrarily modify other account balances, etc.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.9. Gas consumption detection【PASS】

Check whether the consumption of gas exceeds the maximum block limit.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.10. call injection attack【PASS】

When the call function is called, strict permission control should be done, or the function called by the call should be written dead.

Audit result: After testing, the smart contract does not use the call function, and this vulnerability does not exist.

Recommendation： nothing.

4.11. Low-level function safety【PASS】

Check whether there are security vulnerabilities in the use of low-level functions (call/delegatecall) in the contract code implementation

The execution context of the call function is in the called contract; the execution context of the delegatecall function is in the contract that currently calls the function.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.12. Vulnerability of additional token issuance【PASS】

Check whether there is a function that may increase the total amount of tokens in the token contract after initializing the total amount of tokens.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.13. Access control defect detection【PASS】

Different functions in the contract should set reasonable permissions.

Check whether each function in the contract correctly uses keywords such as public and private for visibility modification, check whether the contract is correctly defined and use modifier to restrict access to key functions to avoid problems caused by unauthorized access.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.14. Numerical overflow detection【PASS】

The arithmetic problems in smart contracts refer to integer overflow and integer underflow.

Solidity can handle up to 256-bit numbers (2^256-1). If the maximum number increases by 1, it will overflow to 0. Similarly, when the number is an unsigned type, 0 minus 1 will underflow to get the maximum digital value.

Integer overflow and underflow are not a new type of vulnerability, but they are especially dangerous in smart contracts. Overflow conditions can lead to incorrect

results, especially if the possibility is not expected, which may affect the reliability and safety of the program.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.15. Arithmetic accuracy error【PASS】

As a programming language, Solidity has data structure design similar to ordinary programming languages, such as variables, constants, functions, arrays, functions, structures, etc. There is also a big difference between Solidity and ordinary programming languages-Solidity does not float Point type, and all the numerical calculation results of Solidity will only be integers, there will be no decimals, and it is not allowed to define decimal type data. Numerical calculations in the contract are indispensable, and the design of numerical calculations may cause relative errors. For example, the same level of calculations: 5/2*10=20, and 5*10/2=25, resulting in errors, which are larger in data The error will be larger and more obvious.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.16. Incorrect use of random numbers【PASS】

Smart contracts may need to use random numbers. Although the functions and variables provided by Solidity can access values that are obviously unpredictable, such as block.number and block.timestamp, they are usually more public than they appear or are affected by miners. These random numbers are predictable to a certain extent, so malicious users can usually copy it and rely on its unpredictability to attack the function.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.17. Unsafe interface usage【PASS】

Check whether unsafe interfaces are used in the contract code implementation.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.18. Variable coverage【PASS】

Check whether there are security issues caused by variable coverage in the contract code implementation.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.19. Uninitialized storage pointer【PASS】

In solidity, a special data structure is allowed to be a struct structure, and the local variables in the function are stored in storage or memory by default.

The existence of storage (memory) and memory (memory) are two different concepts. Solidity allows pointers to point to an uninitialized reference, while uninitialized local storage will cause variables to point to other storage variables, leading to variable coverage, or even more serious As a consequence, you should avoid initializing struct variables in functions during development.

Audit result: After testing, the smart contract code does not use structure, there is no such problem.

Recommendation： nothing.

4.20. Return value call verification【PASS】

This problem mostly occurs in smart contracts related to currency transfer, so it is also called silent failed delivery or unchecked delivery.

In Solidity, there are transfer(), send(), call.value() and other currency transfer methods, which can all be used to send BNB to an address. The difference is: When the transfer fails, it will be thrown and the state will be rolled back; Only 2300gas will be passed for calling to prevent reentry attacks; false will be returned when send fails; only 2300gas will be passed for calling to prevent reentry attacks; false will be

returned when call.value fails to be sent; all available gas will be passed for calling (can be Limit by passing in gas_value parameters), which cannot effectively prevent reentry attacks.

If the return value of the above send and call.value transfer functions is not checked in the code, the contract will continue to execute the following code, which may lead to unexpected results due to BNB sending failure.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.21. Transaction order dependency【PASS】

Since miners always get gas fees through codes that represent externally owned addresses (EOA), users can specify higher fees for faster transactions. Since the Ethereum blockchain is public, everyone can see the content of other people's pending transactions. This means that if a user submits a valuable solution, a malicious user can steal the solution and copy its transaction at a higher fee to preempt the original solution.

Audit result: After testing, the _approve function in the contract has a transaction sequence dependency attack risk, but the vulnerability is extremely difficult to exploit, so it is rated as passed. The code is as follows:

```
function _approve(address owner, address spender, uint256 amount) internal virtual {
        require(owner != address(0), "ERC20: approve from the zero address");
        require(spender != address(0), "ERC20: approve to the zero address"); //knownsec//
```

```
There is a risk of transaction order dependency here, it is recommended to add the following statement to judge
        //require((amout == 0) || (_allowed[owner][spender] == 0));
        _allowances[owner][spender] = amount;
        emit Approval(owner, spender, amount);
    }
```

The possible security risks are described as follows:

1. By calling the approve function, user A allows user B to transfer money on his behalf to N (N>0);

2. After a period of time, user A decides to change N to M (M>0), so call the approve function again;

3. User B quickly calls the transferFrom function to transfer N number of tokens before the second call is processed by the miner;

4. After user A's second call to approve is successful, user B can obtain M's transfer quota again, that is, user B obtains N+M's transfer quota through the transaction sequence attack.

Recommendation：

1. Front-end restriction, when user A changes the quota from N to M, he can first change from N to 0, and then from 0 to M.

2. Add the following code at the beginning of the approve function:

require((_value == 0) || (allowed[msg.sender][_spender] == 0));

4.22. Timestamp dependency attack【PASS】

The timestamp of the data block usually uses the local time of the miner, and this time can fluctuate in the range of about 900 seconds. When other nodes accept a new block, it only needs to verify whether the timestamp is later than the previous block and The error with local time is within 900 seconds. A miner can profit from it by setting the timestamp of the block to satisfy the conditions that are beneficial to him as much as possible.

Check whether there are key functions that depend on the timestamp in the contract code implementation.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.23. Denial of service attack【PASS】

In the world of Ethereum, denial of service is fatal, and a smart contract that has suffered this type of attack may never be able to return to its normal working state. There may be many reasons for the denial of service of the smart contract, including malicious behavior as the transaction recipient, artificially increasing the gas required for computing functions to cause gas exhaustion, abusing access control to access the private component of the smart contract, using confusion and negligence, etc. Wait.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.24. Fake recharge vulnerability【PASS】

The transfer function of the token contract uses the if judgment method to check the balance of the transfer initiator (msg.sender). When balances[msg.sender] <value, enter the else logic part and return false, and finally no exception is thrown. We believe that only if/else this kind of gentle judgment method is an imprecise coding method in sensitive function scenarios such as transfer.

Audit result: After testing, the security problem does not exist in the smart contract code.

Recommendation： nothing.

4.25. Reentry attack detection【PASS】

The **call.value()** function in Solidity consumes all the gas it receives when it is used to send BNB. When the **call.value()** function to send BNB occurs before the actual reduction of the sender's account balance, There is a risk of reentry attacks.

Audit results： After auditing, the vulnerability does not exist in the smart contract code.

Recommendation： nothing.

4.26. Replay attack detection【PASS】

If the contract involves the need for entrusted management, attention should be paid to the non-reusability of verification to avoid replay attacks

In the asset management system, there are often cases of entrusted management. The principal assigns assets to the trustee for management, and the principal pays a certain fee to the trustee. This business scenario is also common in smart contracts.

Audit results： After testing, the smart contract does not use the call function, and this vulnerability does not exist.

Recommendation： nothing.

4.27. Rearrangement attack detection【PASS】

A rearrangement attack refers to a miner or other party trying to "compete" with smart contract participants by inserting their own information into a list or mapping, so that the attacker has the opportunity to store their own information in the contract. in.

Audit results： After auditing, the vulnerability does not exist in the smart contract code.

Recommendation： nothing.

5. Appendix A：Contract code

Source code：

GalaxyReward.sol

```
// File: @openzeppelin/contracts/math/Math.sol

pragma solidity ^0.6.0;

/**
 * @dev Standard math utilities missing in the Solidity language.
 */
library Math {
    /**
     * @dev Returns the largest of two numbers.
     */
    function max(uint256 a, uint256 b) internal pure returns (uint256) {
        return a >= b ? a : b;
    }

    /**
     * @dev Returns the smallest of two numbers.
     */
    function min(uint256 a, uint256 b) internal pure returns (uint256) {
        return a < b ? a : b;
    }

    /**
     * @dev Returns the average of two numbers. The result is rounded towards
     * zero.
     */
    function average(uint256 a, uint256 b) internal pure returns (uint256) {
        // (a + b) / 2 can overflow, so we distribute
        return (a / 2) + (b / 2) + ((a % 2 + b % 2) / 2);
    }
}


/**
 * @dev Wrappers over Solidity's arithmetic operations with added overflow
 * checks.
 *
 * Arithmetic operations in Solidity wrap on overflow. This can easily result
 * in bugs, because programmers usually assume that an overflow raises an
 * error, which is the standard behavior in high level programming languages.
 * `SafeMath` restores this intuition by reverting the transaction when an
 * operation overflows.
 *
 * Using this library instead of the unchecked operations eliminates an entire
 * class of bugs, so it's recommended to use it always.
 */
library SafeMath {
    /**
     * @dev Returns the addition of two unsigned integers, reverting on
     * overflow.
     *
     * Counterpart to Solidity's `+` operator.
     *
     * Requirements:
     * - Addition cannot overflow.
     */
    function add(uint256 a, uint256 b) internal pure returns (uint256) {
        uint256 c = a + b;
        require(c >= a, "SafeMath: addition overflow");

        return c;
    }

    /**
     * @dev Returns the subtraction of two unsigned integers, reverting on
     * overflow (when the result is negative).
     *
     * Counterpart to Solidity's `-` operator.
     *
     * Requirements:
     * - Subtraction cannot overflow.
     */
    function sub(uint256 a, uint256 b) internal pure returns (uint256) {
        return sub(a, b, "SafeMath: subtraction overflow");
    }
```

```
    /**
     * @dev Returns the subtraction of two unsigned integers, reverting with custom message on
     * overflow (when the result is negative).
     *
     * Counterpart to Solidity's `-` operator.
     *
     * Requirements:
     * - Subtraction cannot overflow.
     *
     * _Available since v2.4.0._
     */
    function sub(uint256 a, uint256 b, string memory errorMessage) internal pure returns (uint256) {
        require(b <= a, errorMessage);
        uint256 c = a - b;

        return c;
    }

    /**
     * @dev Returns the multiplication of two unsigned integers, reverting on
     * overflow.
     *
     * Counterpart to Solidity's `*` operator.
     *
     * Requirements:
     * - Multiplication cannot overflow.
     */
    function mul(uint256 a, uint256 b) internal pure returns (uint256) {
        // Gas optimization: this is cheaper than requiring 'a' not being zero, but the
        // benefit is lost if 'b' is also tested.
        // See: https://github.com/OpenZeppelin/openzeppelin-contracts/pull/522
        if (a == 0) {
            return 0;
        }

        uint256 c = a * b;
        require(c / a == b, "SafeMath: multiplication overflow");

        return c;
    }

    /**
     * @dev Returns the integer division of two unsigned integers. Reverts on
     * division by zero. The result is rounded towards zero.
     *
     * Counterpart to Solidity's `/` operator. Note: this function uses a
     * `revert` opcode (which leaves remaining gas untouched) while Solidity
     * uses an invalid opcode to revert (consuming all remaining gas).
     *
     * Requirements:
     * - The divisor cannot be zero.
     */
    function div(uint256 a, uint256 b) internal pure returns (uint256) {
        return div(a, b, "SafeMath: division by zero");
    }

    /**
     * @dev Returns the integer division of two unsigned integers. Reverts with custom message on
     * division by zero. The result is rounded towards zero.
     *
     * Counterpart to Solidity's `/` operator. Note: this function uses a
     * `revert` opcode (which leaves remaining gas untouched) while Solidity
     * uses an invalid opcode to revert (consuming all remaining gas).
     *
     * Requirements:
     * - The divisor cannot be zero.
     *
     * _Available since v2.4.0._
     */
    function div(uint256 a, uint256 b, string memory errorMessage) internal pure returns (uint256) {
        // Solidity only automatically asserts when dividing by 0
        require(b > 0, errorMessage);
        uint256 c = a / b;
        // assert(a == b * c + a % b); // There is no case in which this doesn't hold

        return c;
    }

    /**
     * @dev Returns the remainder of dividing two unsigned integers. (unsigned integer modulo),
     * Reverts when dividing by zero.
     *
     * Counterpart to Solidity's `%` operator. This function uses a `revert`
     * opcode (which leaves remaining gas untouched) while Solidity uses an
     * invalid opcode to revert (consuming all remaining gas).
     *
```

```
     * Requirements:
     * - The divisor cannot be zero.
     */
    function mod(uint256 a, uint256 b) internal pure returns (uint256) {
        return mod(a, b, "SafeMath: modulo by zero");
    }

    /**
     * @dev Returns the remainder of dividing two unsigned integers. (unsigned integer modulo),
     * Reverts with custom message when dividing by zero.
     *
     * Counterpart to Solidity's `%` operator. This function uses a `revert`
     * opcode (which leaves remaining gas untouched) while Solidity uses an
     * invalid opcode to revert (consuming all remaining gas).
     *
     * Requirements:
     * - The divisor cannot be zero.
     *
     * _Available since v2.4.0._
     */
    function mod(uint256 a, uint256 b, string memory errorMessage) internal pure returns (uint256) {
        require(b != 0, errorMessage);
        return a % b;
    }
}

/*
 * @dev Provides information about the current execution context, including the
 * sender of the transaction and its data. While these are generally available
 * via msg.sender and msg.data, they should not be accessed in such a direct
 * manner, since when dealing with GSN meta-transactions the account sending and
 * paying for execution may not be the actual sender (as far as an application
 * is concerned).
 *
 * This contract is only required for intermediate, library-like contracts.
 */
contract Context {
    // Empty internal constructor, to prevent people from mistakenly deploying
    // an instance of this contract, which should be used via inheritance.
    constructor () internal { }
    // solhint-disable-previous-line no-empty-blocks

    function _msgSender() internal view returns (address payable) {
        return msg.sender;
    }

    function _msgData() internal view returns (bytes memory) {
        this; // silence state mutability warning without generating bytecode - see https://github.com/ethereum/solidity/issues/2691
        return msg.data;
    }
}

/**
 * @dev Contract module which provides a basic access control mechanism, where
 * there is an account (an owner) that can be granted exclusive access to
 * specific functions.
 *
 * This module is used through inheritance. It will make available the modifier
 * `onlyOwner`, which can be applied to your functions to restrict their use to
 * the owner.
 */
contract Ownable is Context {
    address private _owner;

    event OwnershipTransferred(address indexed previousOwner, address indexed newOwner);

    /**
     * @dev Initializes the contract setting the deployer as the initial owner.
     */
    constructor () internal {
        address msgSender = _msgSender();
        _owner = msgSender;
        emit OwnershipTransferred(address(0), msgSender);
    }

    /**
     * @dev Returns the address of the current owner.
     */
    function owner() public view returns (address) {
        return _owner;
    }

    /**
     * @dev Throws if called by any account other than the owner.
     */
    modifier onlyOwner() {
```

```
        require(isOwner(), "Ownable: caller is not the owner");
        _;
    }

    /**
     * @dev Returns true if the caller is the current owner.
     */
    function isOwner() public view returns (bool) {
        return _msgSender() == _owner;
    }

    /**
     * @dev Leaves the contract without owner. It will not be possible to call
     * `onlyOwner` functions anymore. Can only be called by the current owner.
     *
     * NOTE: Renouncing ownership will leave the contract without an owner,
     * thereby removing any functionality that is only available to the owner.
     */
    function renounceOwnership() public onlyOwner {
        emit OwnershipTransferred(_owner, address(0));
        _owner = address(0);
    }

    /**
     * @dev Transfers ownership of the contract to a new account (`newOwner`).
     * Can only be called by the current owner.
     */
    function transferOwnership(address newOwner) public onlyOwner {
        _transferOwnership(newOwner);
    }

    /**
     * @dev Transfers ownership of the contract to a new account (`newOwner`).
     */
    function _transferOwnership(address newOwner) internal {
        require(newOwner != address(0), "Ownable: new owner is the zero address");
        emit OwnershipTransferred(_owner, newOwner);
        _owner = newOwner;
    }
}


/**
 * @dev Interface of the ERC20 standard as defined in the EIP. Does not include
 * the optional functions; to access them see {ERC20Detailed}.
 */
interface IERC20 {
    /**
     * @dev Returns the amount of tokens in existence.
     */
    function totalSupply() external view returns (uint256);

    /**
     * @dev Returns the amount of tokens owned by `account`.
     */
    function balanceOf(address account) external view returns (uint256);

    /**
     * @dev Moves `amount` tokens from the caller's account to `recipient`.
     *
     * Returns a boolean value indicating whether the operation succeeded.
     *
     * Emits a {Transfer} event.
     */
    function transfer(address recipient, uint256 amount) external returns (bool);
    function mint(address account, uint amount) external;
    /**
     * @dev Returns the remaining number of tokens that `spender` will be
     * allowed to spend on behalf of `owner` through {transferFrom}. This is
     * zero by default.
     *
     * This value changes when {approve} or {transferFrom} are called.
     */
    function allowance(address owner, address spender) external view returns (uint256);

    /**
     * @dev Sets `amount` as the allowance of `spender` over the caller's tokens.
     *
     * Returns a boolean value indicating whether the operation succeeded.
     *
     * IMPORTANT: Beware that changing an allowance with this method brings the risk
     * that someone may use both the old and the new allowance by unfortunate
     * transaction ordering. One possible solution to mitigate this race
     * condition is to first reduce the spender's allowance to 0 and set the
     * desired value afterwards:
     * https://github.com/ethereum/EIPs/issues/20#issuecomment-263524729
     *
```

```
     * Emits an {Approval} event.
     */
    function approve(address spender, uint256 amount) external returns (bool);

    /**
     * @dev Moves `amount` tokens from `sender` to `recipient` using the
     * allowance mechanism. `amount` is then deducted from the caller's
     * allowance.
     *
     * Returns a boolean value indicating whether the operation succeeded.
     *
     * Emits a {Transfer} event.
     */
    function transferFrom(address sender, address recipient, uint256 amount) external returns (bool);

    /**
     * @dev Emitted when `value` tokens are moved from one account (`from`) to
     * another (`to`).
     *
     * Note that `value` may be zero.
     */
    event Transfer(address indexed from, address indexed to, uint256 value);

    /**
     * @dev Emitted when the allowance of a `spender` for an `owner` is set by
     * a call to {approve}. `value` is the new allowance.
     */
    event Approval(address indexed owner, address indexed spender, uint256 value);
}


interface IPool {
    function totalSupply( ) external view virtual returns (uint256);
    function balanceOf( address player ) external view virtual returns (uint256);
}


/**
 * @dev Collection of functions related to the address type
 */
library Address {
    /**
     * @dev Returns true if `account` is a contract.
     *
     * [IMPORTANT]
     * [IMPORTANT]
     * ====
     * It is unsafe to assume that an address for which this function returns
     * false is an externally-owned account (EOA) and not a contract.
     *
     * Among others, `isContract` will return false for the following
     * types of addresses:
     *
     *  - an externally-owned account
     *  - a contract in construction
     *  - an address where a contract will be created
     *  - an address where a contract lived, but was destroyed
     * ====
     */
    function isContract(address account) internal view returns (bool) {
        // According to EIP-1052, 0x0 is the value returned for not-yet created accounts
        // and 0xc5d2460186f7233c927e7db2dcc703c0e500b653ca82273b7bfad8045d85a470 is returned
        // for accounts without code, i.e. `keccak256('')`
        bytes32 codehash;
        bytes32 accountHash = 0xc5d2460186f7233c927e7db2dcc703c0e500b653ca82273b7bfad8045d85a470;
        // solhint-disable-next-line no-inline-assembly
        assembly { codehash := extcodehash(account) }
        return (codehash != accountHash && codehash != 0x0);
    }

    /**
     * @dev Converts an `address` into `address payable`. Note that this is
     * simply a type cast: the actual underlying value is not changed.
     *
     * _Available since v2.4.0._
     */
    function toPayable(address account) internal pure returns (address payable) {
        return address(uint160(account));
    }

    /**
     * @dev Replacement for Solidity's `transfer`: sends `amount` wei to
     * `recipient`, forwarding all available gas and reverting on errors.
     *
     * https://eips.ethereum.org/EIPS/eip-1884[EIP1884] increases the gas cost
     * of certain opcodes, possibly making contracts go over the 2300 gas limit
```

```
     * imposed by `transfer`, making them unable to receive funds via
     * `transfer`. {sendValue} removes this limitation.
     *
     * https://diligence.consensys.net/posts/2019/09/stop-using-soliditys-transfer-now/[Learn more].
     *
     * IMPORTANT: because control is transferred to `recipient`, care must be
     * taken to not create reentrancy vulnerabilities. Consider using
     * {ReentrancyGuard} or the
     * `https://solidity.readthedocs.io/en/v0.5.11/security-considerations.html#use-the-checks-effects-interactions-pattern[checks-effects-interactions pattern].
     *
     * _Available since v2.4.0._
     */
    function sendValue(address payable recipient, uint256 amount) internal {
        require(address(this).balance >= amount, "Address: insufficient balance");

        // solhint-disable-next-line avoid-call-value
        (bool success, ) = recipient.call.value(amount)("");
        require(success, "Address: unable to send value, recipient may have reverted");
    }
}

/**
 * @title SafeERC20
 * @dev Wrappers around ERC20 operations that throw on failure (when the token
 * contract returns false). Tokens that return no value (and instead revert or
 * throw on failure) are also supported, non-reverting calls are assumed to be
 * successful.
 * To use this library you can add a `using SafeERC20 for ERC20;` statement to your contract,
 * which allows you to call the safe operations as `token.safeTransfer(...)`, etc.
 */
library SafeERC20 {
    using SafeMath for uint256;
    using Address for address;

    bytes4 private constant SELECTOR = bytes4(keccak256(bytes('transfer(address,uint256)')));

    function safeTransfer(IERC20 token, address to, uint256 value) internal {
        (bool success, bytes memory data) = address(token).call(abi.encodeWithSelector(SELECTOR, to, value));
        require(success && (data.length == 0 || abi.decode(data, (bool))), 'SafeERC20: TRANSFER_FAILED');
    }
    // function safeTransfer(IERC20 token, address to, uint256 value) internal {
    //         callOptionalReturn(token, abi.encodeWithSelector(token.transfer.selector, to, value));
    // }

    function safeTransferFrom(IERC20 token, address from, address to, uint256 value) internal {
        callOptionalReturn(token, abi.encodeWithSelector(token.transferFrom.selector, from, to, value));
    }

    function safeApprove(IERC20 token, address spender, uint256 value) internal {
        // safeApprove should only be called when setting an initial allowance,
        // or when resetting it to zero. To increase and decrease it, use
        // 'safeIncreaseAllowance' and 'safeDecreaseAllowance'
        // solhint-disable-next-line max-line-length
        require((value == 0) || (token.allowance(address(this), spender) == 0),
            "SafeERC20: approve from non-zero to non-zero allowance"
        );
        callOptionalReturn(token, abi.encodeWithSelector(token.approve.selector, spender, value));
    }

    function safeIncreaseAllowance(IERC20 token, address spender, uint256 value) internal {
        uint256 newAllowance = token.allowance(address(this), spender).add(value);
        callOptionalReturn(token, abi.encodeWithSelector(token.approve.selector, spender, newAllowance));
    }

    function safeDecreaseAllowance(IERC20 token, address spender, uint256 value) internal {
        uint256 newAllowance = token.allowance(address(this), spender).sub(value, "SafeERC20: decreased allowance below zero");
        callOptionalReturn(token, abi.encodeWithSelector(token.approve.selector, spender, newAllowance));
    }

    /**
     * @dev Imitates a Solidity high-level call (i.e. a regular function call to a contract), relaxing the requirement
     * on the return value: the return value is optional (but if data is returned, it must not be false).
     * @param token The token targeted by the call.
     * @param data The call data (encoded using abi.encode or one of its variants).
     */
    function callOptionalReturn(IERC20 token, bytes memory data) private {
        // We need to perform a low level call here, to bypass Solidity's return data size checking mechanism, since
        // we're implementing it ourselves.

        // A Solidity high level call has three parts:
        //   1. The target address is checked to verify it contains contract code
        //   2. The call itself is made, and success asserted
        //   3. The return value is decoded, which in turn checks the size of the returned data.
        // solhint-disable-next-line max-line-length
        require(address(token).isContract(), "SafeERC20: call to non-contract");
```

```
            // solhint-disable-next-line avoid-low-level-calls
            (bool success, bytes memory returndata) = address(token).call(data);
            require(success, "SafeERC20: low-level call failed");

            if (returndata.length > 0) { // Return data is optional
                // solhint-disable-next-line max-line-length
                require(abi.decode(returndata, (bool)), "SafeERC20: ERC20 operation did not succeed");
            }
        }
}


interface ERC20 {
    function name() external view returns (string memory);
    function symbol() external view returns (string memory);
    function decimals() external view returns (uint8);
}

contract Governance {

    address public _governance;

    constructor() public {
        _governance = tx.origin;
    }

    event GovernanceTransferred(address indexed previousOwner, address indexed newOwner);

    modifier onlyGovernance {
        require(msg.sender == _governance, "not governance");
        _;
    }

    function setGovernance(address governance)  public  onlyGovernance
    {
        require(governance != address(0), "new governance the zero address");
        emit GovernanceTransferred(_governance, governance);
        _governance = governance;
    }


}

interface IPancakeFactory {
    event PairCreated(address indexed token0, address indexed token1, address pair, uint);

    function feeTo() external view returns (address);
    function feeToSetter() external view returns (address);

    function getPair(address tokenA, address tokenB) external view returns (address pair);
    function allPairs(uint) external view returns (address pair);
    function allPairsLength() external view returns (uint);

    function createPair(address tokenA, address tokenB) external returns (address pair);

    function setFeeTo(address) external;
    function setFeeToSetter(address) external;
}

interface IPancakePair {
    event Approval(address indexed owner, address indexed spender, uint value);
    event Transfer(address indexed from, address indexed to, uint value);

    function name() external pure returns (string memory);
    function symbol() external pure returns (string memory);
    function decimals() external pure returns (uint8);
    function totalSupply() external view returns (uint);
    function balanceOf(address owner) external view returns (uint);
    function allowance(address owner, address spender) external view returns (uint);

    function approve(address spender, uint value) external returns (bool);
    function transfer(address to, uint value) external returns (bool);
    function transferFrom(address from, address to, uint value) external returns (bool);

    function DOMAIN_SEPARATOR() external view returns (bytes32);
    function PERMIT_TYPEHASH() external pure returns (bytes32);
    function nonces(address owner) external view returns (uint);

    function permit(address owner, address spender, uint value, uint deadline, uint8 v, bytes32 r, bytes32 s) external;

    event Mint(address indexed sender, uint amount0, uint amount1);
    event Burn(address indexed sender, uint amount0, uint amount1, address indexed to);
    event Swap(
        address indexed sender,
        uint amount0In,
        uint amount1In,
```

```
        uint amount0Out,
        uint amount1Out,
        address indexed to
    );
    event Sync(uint112 reserve0, uint112 reserve1);

    function MINIMUM_LIQUIDITY() external pure returns (uint);
    function factory() external view returns (address);
    function token0() external view returns (address);
    function token1() external view returns (address);
    function getReserves() external view returns (uint112 reserve0, uint112 reserve1, uint32 blockTimestampLast);
    function price0CumulativeLast() external view returns (uint);
    function price1CumulativeLast() external view returns (uint);
    function kLast() external view returns (uint);

    function mint(address to) external returns (uint liquidity);
    function burn(address to) external returns (uint amount0, uint amount1);
    function swap(uint amount0Out, uint amount1Out, address to, bytes calldata data) external;
    function skim(address to) external;
    function sync() external;

    function initialize(address, address) external;
}

interface IPowerStrategy {
    function lpIn(address sender, uint256 amount) external;
    function lpOut(address sender, uint256 amount) external;

    function getPower(address sender) view    external returns (uint256);
}

contract LPTokenWrapper is IPool,Governance {
    using SafeMath for uint256;
    using SafeERC20 for IERC20;

    IERC20 public _lpToken = IERC20(0xd81AeC86B83c5b879001484CD45594C6c9cfC1d7);

    uint256 private _totalSupply;
    mapping(address => uint256) private _balances;

    uint256 private _totalPower;
    mapping(address => uint256) private _powerBalances;

    address public _powerStrategy = address(0x0);


    function totalSupply() public view override returns (uint256) {
        return _totalSupply;
    }

    function setPowerStragegy(address strategy)    public    onlyGovernance{
        _powerStrategy = strategy;
    }

    function balanceOf(address account) public view override returns (uint256) {
        return _balances[account];
    }

    function balanceOfPower(address account) public view returns (uint256) {
        return _powerBalances[account];
    }


    function totalPower() public view returns (uint256) {
        return _totalPower;
    }


    function stake(uint256 amount) public virtual { //knownsec//质押
        _totalSupply = _totalSupply.add(amount); //knownsec//建议对质押的数量 amount 进行大于 0 判断
        _balances[msg.sender] = _balances[msg.sender].add(amount);

        if( _powerStrategy != address(0x0)){ //knownsec// _powerStrategy 存在
            _totalPower = _totalPower.sub(_powerBalances[msg.sender]);
            IPowerStrategy(_powerStrategy).lpIn(msg.sender, amount);

            _powerBalances[msg.sender]        =        IPowerStrategy(_powerStrategy).getPower(msg.sender);
//knownsec//存入 amount 获取用户 power 的新的 balances
            _totalPower = _totalPower.add(_powerBalances[msg.sender]);
        }else{ //knownsec//不存在则将当前的值设为初始值
            _totalPower = _totalSupply;
            _powerBalances[msg.sender] = _balances[msg.sender];
        }

        _lpToken.safeTransferFrom(msg.sender, address(this), amount);
    }
```

```
    function withdraw(uint256 amount) public virtual{ //knownsec//提现
        require(amount > 0, "amout > 0"); //knownec//提现的数量要大于0

        _totalSupply = _totalSupply.sub(amount);
        _balances[msg.sender] = _balances[msg.sender].sub(amount);

        if( _powerStrategy != address(0x0)){ //knownsec// _powerStrategy 存在
            totalPower = _totalPower.sub(_powerBalances[msg.sender]);
            IPowerStrategy(_powerStrategy).lpOut(msg.sender, amount);
            powerBalances[msg.sender] = IPowerStrategy(_powerStrategy).getPower(msg.sender);
//knownsec//取出 amount 获取用户 power 的新的 balances
            _totalPower = _totalPower.add(_powerBalances[msg.sender]);

        }else{ //knownsec//不存在则将当前的值设为初始值
            _totalPower = _totalSupply;
            _powerBalances[msg.sender] = _balances[msg.sender];
        }

        _lpToken.safeTransfer( msg.sender, amount);
    }
}

contract GalaxyReward is LPTokenWrapper{
    using SafeMath for uint256;
    using SafeERC20 for IERC20;

    address public WBNB = 0xbb4CdB9CBd36B01bD1cBaEBF2De08d9173bc095c;
    address public USDT = 0x55d398326f99059fF775485246999027B3197955;
    address public GFC = 0xe3F4006ee7d620D4195089Ce89aE8567b5CE7d4E;

    address public pancakeFactory = 0xBCfCcbde45cE874adCB698cC183deBcF17952812;

    IERC20 public _gfc = IERC20(GFC);
    IERC20 public _gfv = IERC20(0x683c88095870a3aBF5cdD2Dc79A4A10d6bECD9D5);

    uint256 public constant DURATION = 1 hours;

    uint256 public _initReward = 1501465 * 1e18;


    uint256 public _startTime =   now    + 365 days;
    uint256 public _periodFinish = 0;
    uint256 public _rewardRate = 0;
    uint256 public _lastUpdateTime;
    uint256 public _rewardPerTokenStored;

    uint256 public _halfTimesTotal = 10;
    uint256 public _halfTimes = 0;

    mapping(address => uint256) public _userRewardPerTokenPaid;
    mapping(address => uint256) public _rewards;
    mapping(address => uint256) public _lastStakedTime;

    bool public _hasStart = false;

    event RewardAdded(uint256 reward);
    event Staked(address indexed user, uint256 amount);
    event Withdrawn(address indexed user, uint256 amount);
    event RewardGFCPaid(address indexed user, uint256 reward);
    event RewardGFVPaid(address indexed user, uint256 reward);


    modifier updateReward(address account) {
        _rewardPerTokenStored = rewardPerToken();
        _lastUpdateTime = lastTimeRewardApplicable();
        if (account != address(0)) {
            _rewards[account] = earned(account);
            _userRewardPerTokenPaid[account] = _rewardPerTokenStored;
        }
        _;
    }

    modifier checkHalve() {
        if (block.timestamp >= _periodFinish && _halfTimes < _halfTimesTotal) {
            _initReward = _initReward.mul(50).div(100);

            _rewardRate = _initReward.div(DURATION);
            _lastUpdateTime = block.timestamp;
            _periodFinish = block.timestamp.add(DURATION);
            _halfTimes = _halfTimes + 1;
            emit RewardAdded(_initReward);
        }
        _;
    }

    modifier checkStart() {
```

```
        require(block.timestamp > _startTime, "not start");
        _;
    }

    /* Fee collection for any other token */
    function seize(IERC20 token, uint256 amount) external onlyGovernance{
        require(token != _lpToken, "stake");
        token.safeTransfer(_governance, amount);
    }

    function lastTimeRewardApplicable() public view returns (uint256) {
        return Math.min(block.timestamp, _periodFinish);
    }

    function rewardPerToken() public view returns (uint256) {
        if (totalPower() == 0) {
            return _rewardPerTokenStored;
        }
        return
        _rewardPerTokenStored.add(
            lastTimeRewardApplicable()
            .sub(_lastUpdateTime)
            .mul(_rewardRate)
            .mul(1e18)
            .div(totalPower())
        );
    }

    function earned(address account) public view returns (uint256) {
        return
        balanceOfPower(account)
        .mul(rewardPerToken().sub(_userRewardPerTokenPaid[account]))
        .div(1e18)
        .add(_rewards[account]);
    }

    function earnedGFV(address account) public view returns (uint256) {
        uint256 r = earned(account);
        return calcGFV(r);
    }

    function calcGFV(uint256 r) public view returns (uint256) {
        uint256 price = gfcPrice();
        return r.mul(price).mul(uint256(1e10).div(6231).add(1e9)).div(1e28);
    }

    // stake visibility is public as overriding LPTokenWrapper's stake() function
    function stake(uint256 amount)
    public
    override
    updateReward(msg.sender)
    checkHalve
    checkStart
    {
        require(amount > 0, "Cannot stake 0");
        super.stake(amount);

        _lastStakedTime[msg.sender] = now;

        emit Staked(msg.sender, amount);
    }

    function withdraw(uint256 amount)
    public
    override
    updateReward(msg.sender)
    checkHalve
    checkStart
    {
        require(amount > 0, "Cannot withdraw 0");
        super.withdraw(amount);
        emit Withdrawn(msg.sender, amount);
    }

    function exit() external {
        withdraw(balanceOf(msg.sender));
        getReward();
    }

    function gfcPrice() public view returns (uint256) {
        //uint256 usdt_bnb = getPairPrice(USDT,WBNB);
        //uint256 bnb_gfc = getPairPrice(WBNB,GFC);
        // return usdt_bnb.mul(bnb_gfc).div(10**18);
        return getPairPrice(USDT,GFC);
    }

    function getPairPrice(address token0,address token1) public view returns (uint256) {
```

```
        IPancakeFactory factory = IPancakeFactory(pancakeFactory);
        address pairAddress = factory.getPair(token0,token1);
        if(pairAddress == address (0x0)) { //knownsec//交易对地址为0 说明交易对不存在
            return 0;
        }

        IPancakePair pair = IPancakePair(pairAddress);
        (uint112 _reserve0, uint112 _reserve1,) = pair.getReserves();
        (uint256 value0,uint256 value1) = token0 == pair.token0() ? (uint256(_reserve0),uint256(_reserve1)) :
(uint256(_reserve1),uint256(_reserve0));
        uint256 decimals0 = uint256(ERC20(token0).decimals());
        uint256 decimals1 = uint256(ERC20(token1).decimals());

        return    uint256(10**18).mul(uint256(10    **    decimals1)).mul(value0).div(value1).div(uint256(10**
decimals0)) ;
    }

    function getReward() public
    updateReward(msg.sender)
    checkHalve
    checkStart {
        uint256 reward = earned(msg.sender);
        if (reward > 0) {
            _rewards[msg.sender] = 0;
            _gfc.safeTransfer(msg.sender, reward );

            uint256 rewardGFV = calcGFV(reward);
            _gfv.mint(msg.sender,rewardGFV);

            emit RewardGFCPaid(msg.sender, reward);
        }
    }

    // set fix time to start reward
    function startReward(uint256 startTime)
    external
    onlyGovernance
    updateReward(address(0))
    {
        require(_hasStart == false, "has started");
        _hasStart = true;

        _startTime = startTime;

        _rewardRate = _initReward.div(DURATION);

        _lastUpdateTime = _startTime;
        _periodFinish = _startTime.add(DURATION);

        emit RewardAdded(_initReward);
    }

    //

    //for extra reward
    function notifyRewardAmount(uint256 reward)
    external
    onlyGovernance
    updateReward(address(0))
    {
        IERC20(_gfc).safeTransferFrom(msg.sender, address(this), reward);
        if (block.timestamp >= _periodFinish) {
            _rewardRate = reward.div(DURATION);
        } else {
            uint256 remaining = _periodFinish.sub(block.timestamp);
            uint256 leftover = remaining.mul(_rewardRate);
            _rewardRate = reward.add(leftover).div(DURATION);
        }
        _lastUpdateTime = block.timestamp;
        _periodFinish = block.timestamp.add(DURATION);
        emit RewardAdded(reward);
    }
}
```

GFV.sol

```
pragma solidity ^0.6.0;

/**
 * @dev Interface of the ERC20 standard as defined in the EIP.
 */
interface IERC20 {
    /**
     * @dev Returns the amount of tokens in existence.
     */
    function totalSupply() external view returns (uint256);
```

```
    /**
     * @dev Returns the amount of tokens owned by `account`.
     */
    function balanceOf(address account) external view returns (uint256);

    /**
     * @dev Moves `amount` tokens from the caller's account to `recipient`.
     *
     * Returns a boolean value indicating whether the operation succeeded.
     *
     * Emits a {Transfer} event.
     */
    function transfer(address recipient, uint256 amount) external returns (bool);

    /**
     * @dev Returns the remaining number of tokens that `spender` will be
     * allowed to spend on behalf of `owner` through {transferFrom}. This is
     * zero by default.
     *
     * This value changes when {approve} or {transferFrom} are called.
     */
    function allowance(address owner, address spender) external view returns (uint256);

    /**
     * @dev Sets `amount` as the allowance of `spender` over the caller's tokens.
     *
     * Returns a boolean value indicating whether the operation succeeded.
     *
     * IMPORTANT: Beware that changing an allowance with this method brings the risk
     * that someone may use both the old and the new allowance by unfortunate
     * transaction ordering. One possible solution to mitigate this race
     * condition is to first reduce the spender's allowance to 0 and set the
     * desired value afterwards:
     * https://github.com/ethereum/EIPs/issues/20#issuecomment-263524729
     *
     * Emits an {Approval} event.
     */
    function approve(address spender, uint256 amount) external returns (bool);

    /**
     * @dev Moves `amount` tokens from `sender` to `recipient` using the
     * allowance mechanism. `amount` is then deducted from the caller's
     * allowance.
     *
     * Returns a boolean value indicating whether the operation succeeded.
     *
     * Emits a {Transfer} event.
     */
    function transferFrom(address sender, address recipient, uint256 amount) external returns (bool);

    /**
     * @dev Emitted when `value` tokens are moved from one account (`from`) to
     * another (`to`).
     *
     * Note that `value` may be zero.
     */
    event Transfer(address indexed from, address indexed to, uint256 value);

    /**
     * @dev Emitted when the allowance of a `spender` for an `owner` is set by
     * a call to {approve}. `value` is the new allowance.
     */
    event Approval(address indexed owner, address indexed spender, uint256 value);
}


/**
 * @dev Wrappers over Solidity's arithmetic operations with added overflow
 * checks.
 *
 * Arithmetic operations in Solidity wrap on overflow. This can easily result
 * in bugs, because programmers usually assume that an overflow raises an
 * error, which is the standard behavior in high level programming languages.
 * `SafeMath` restores this intuition by reverting the transaction when an
 * operation overflows.
 *
 * Using this library instead of the unchecked operations eliminates an entire
 * class of bugs, so it's recommended to use it always.
 */
library SafeMath {
    /**
     * @dev Returns the addition of two unsigned integers, reverting on
     * overflow.
     *
     * Counterpart to Solidity's `+` operator.
     *
```

```
     * Requirements:
     *
     * - Addition cannot overflow.
     */
    function add(uint256 a, uint256 b) internal pure returns (uint256) {
        uint256 c = a + b;
        require(c >= a, "SafeMath: addition overflow");

        return c;
    }

    /**
     * @dev Returns the subtraction of two unsigned integers, reverting on
     * overflow (when the result is negative).
     *
     * Counterpart to Solidity's `-` operator.
     *
     * Requirements:
     *
     * - Subtraction cannot overflow.
     */
    function sub(uint256 a, uint256 b) internal pure returns (uint256) {
        return sub(a, b, "SafeMath: subtraction overflow");
    }

    /**
     * @dev Returns the subtraction of two unsigned integers, reverting with custom message on
     * overflow (when the result is negative).
     *
     * Counterpart to Solidity's `-` operator.
     *
     * Requirements:
     *
     * - Subtraction cannot overflow.
     */
    function sub(uint256 a, uint256 b, string memory errorMessage) internal pure returns (uint256) {
        require(b <= a, errorMessage);
        uint256 c = a - b;

        return c;
    }

    /**
     * @dev Returns the multiplication of two unsigned integers, reverting on
     * overflow.
     *
     * Counterpart to Solidity's `*` operator.
     *
     * Requirements:
     *
     * - Multiplication cannot overflow.
     */
    function mul(uint256 a, uint256 b) internal pure returns (uint256) {
        // Gas optimization: this is cheaper than requiring 'a' not being zero, but the
        // benefit is lost if 'b' is also tested.
        // See: https://github.com/OpenZeppelin/openzeppelin-contracts/pull/522
        if (a == 0) {
            return 0;
        }

        uint256 c = a * b;
        require(c / a == b, "SafeMath: multiplication overflow");

        return c;
    }

    /**
     * @dev Returns the integer division of two unsigned integers. Reverts on
     * division by zero. The result is rounded towards zero.
     *
     * Counterpart to Solidity's `/` operator. Note: this function uses a
     * `revert` opcode (which leaves remaining gas untouched) while Solidity
     * uses an invalid opcode to revert (consuming all remaining gas).
     *
     * Requirements:
     *
     * - The divisor cannot be zero.
     */
    function div(uint256 a, uint256 b) internal pure returns (uint256) {
        return div(a, b, "SafeMath: division by zero");
    }

    /**
     * @dev Returns the integer division of two unsigned integers. Reverts with custom message on
     * division by zero. The result is rounded towards zero.
     *
     * Counterpart to Solidity's `/` operator. Note: this function uses a
```

```
     * `revert` opcode (which leaves remaining gas untouched) while Solidity
     * uses an invalid opcode to revert (consuming all remaining gas).
     *
     * Requirements:
     *
     * - The divisor cannot be zero.
     */
    function div(uint256 a, uint256 b, string memory errorMessage) internal pure returns (uint256) {
        require(b > 0, errorMessage);
        uint256 c = a / b;
        // assert(a == b * c + a % b); // There is no case in which this doesn't hold

        return c;
    }

    /**
     * @dev Returns the remainder of dividing two unsigned integers. (unsigned integer modulo),
     * Reverts when dividing by zero.
     *
     * Counterpart to Solidity's `%` operator. This function uses a `revert`
     * opcode (which leaves remaining gas untouched) while Solidity uses an
     * invalid opcode to revert (consuming all remaining gas).
     *
     * Requirements:
     *
     * - The divisor cannot be zero.
     */
    function mod(uint256 a, uint256 b) internal pure returns (uint256) {
        return mod(a, b, "SafeMath: modulo by zero");
    }

    /**
     * @dev Returns the remainder of dividing two unsigned integers. (unsigned integer modulo),
     * Reverts with custom message when dividing by zero.
     *
     * Counterpart to Solidity's `%` operator. This function uses a `revert`
     * opcode (which leaves remaining gas untouched) while Solidity uses an
     * invalid opcode to revert (consuming all remaining gas).
     *
     * Requirements:
     *
     * - The divisor cannot be zero.
     */
    function mod(uint256 a, uint256 b, string memory errorMessage) internal pure returns (uint256) {
        require(b != 0, errorMessage);
        return a % b;
    }
}

/**
 * @dev Collection of functions related to the address type
 */
library Address {
    /**
     * @dev Returns true if `account` is a contract.
     *
     * [IMPORTANT]
     * ====
     * It is unsafe to assume that an address for which this function returns
     * false is an externally-owned account (EOA) and not a contract.
     *
     * Among others, `isContract` will return false for the following
     * types of addresses:
     *
     *  - an externally-owned account
     *  - a contract in construction
     *  - an address where a contract will be created
     *  - an address where a contract lived, but was destroyed
     * ====
     */
    function isContract(address account) internal view returns (bool) {
        // According to EIP-1052, 0x0 is the value returned for not-yet created accounts
        // and 0xc5d2460186f7233c927e7db2dcc703c0e500b653ca82273b7bfad8045d85a470 is returned
        // for accounts without code, i.e. `keccak256('')`
        bytes32 codehash;
        bytes32 accountHash = 0xc5d2460186f7233c927e7db2dcc703c0e500b653ca82273b7bfad8045d85a470;
        // solhint-disable-next-line no-inline-assembly
        assembly { codehash := extcodehash(account) }
        return (codehash != accountHash && codehash != 0x0);
    }

    /**
     * @dev Replacement for Solidity's `transfer`: sends `amount` wei to
     * `recipient`, forwarding all available gas and reverting on errors.
     *
     * https://eips.ethereum.org/EIPS/eip-1884[EIP1884] increases the gas cost
     * of certain opcodes, possibly making contracts go over the 2300 gas limit
```

```
     * imposed by `transfer`, making them unable to receive funds via
     * `transfer`. {sendValue} removes this limitation.
     *
     * https://diligence.consensys.net/posts/2019/09/stop-using-soliditys-transfer-now/[Learn more].
     *
     * IMPORTANT: because control is transferred to `recipient`, care must be
     * taken to not create reentrancy vulnerabilities. Consider using
     * {ReentrancyGuard} or the
     * `https://solidity.readthedocs.io/en/v0.5.11/security-considerations.html#use-the-checks-effects-interactions-pattern[checks-effects-interactions pattern].
     */
    function sendValue(address payable recipient, uint256 amount) internal {
        require(address(this).balance >= amount, "Address: insufficient balance");

        // solhint-disable-next-line avoid-low-level-calls, avoid-call-value
        (bool success, ) = recipient.call{ value: amount }("");
        require(success, "Address: unable to send value, recipient may have reverted");
    }

    /**
     * @dev Performs a Solidity function call using a low level `call`. A
     * plain`call` is an unsafe replacement for a function call: use this
     * function instead.
     *
     * If `target` reverts with a revert reason, it is bubbled up by this
     * function (like regular Solidity function calls).
     *
     * Returns the raw returned data. To convert to the expected return value,
     *    use    https://solidity.readthedocs.io/en/latest/units-and-global-variables.html?highlight=abi.decode#abi-encoding-and-decoding-functions[`abi.decode`].
     *
     * Requirements:
     *
     * - `target` must be a contract.
     * - calling `target` with `data` must not revert.
     *
     * _Available since v3.1._
     */
    function functionCall(address target, bytes memory data) internal returns (bytes memory) {
        return functionCall(target, data, "Address: low-level call failed");
    }

    /**
     * @dev Same as {xref-Address-functionCall-address-bytes-}[`functionCall`], but with
     * `errorMessage` as a fallback revert reason when `target` reverts.
     *
     * _Available since v3.1._
     */
    function functionCall(address target, bytes memory data, string memory errorMessage) internal returns (bytes memory) {
        return _functionCallWithValue(target, data, 0, errorMessage);
    }

    /**
     * @dev Same as {xref-Address-functionCall-address-bytes-}[`functionCall`],
     * but also transferring `value` wei to `target`.
     *
     * Requirements:
     *
     * - the calling contract must have an ETH balance of at least `value`.
     * - the called Solidity function must be `payable`.
     *
     * _Available since v3.1._
     */
    function functionCallWithValue(address target, bytes memory data, uint256 value) internal returns (bytes memory) {
        return functionCallWithValue(target, data, value, "Address: low-level call with value failed");
    }

    /**
     * @dev Same as {xref-Address-functionCallWithValue-address-bytes-uint256-}[`functionCallWithValue`], but
     * with `errorMessage` as a fallback revert reason when `target` reverts.
     *
     * _Available since v3.1._
     */
    function functionCallWithValue(address target, bytes memory data, uint256 value, string memory errorMessage) internal returns (bytes memory) {
        require(address(this).balance >= value, "Address: insufficient balance for call");
        return _functionCallWithValue(target, data, value, errorMessage);
    }

    function _functionCallWithValue(address target, bytes memory data, uint256 weiValue, string memory errorMessage) private returns (bytes memory) {
        require(isContract(target), "Address: call to non-contract");

        // solhint-disable-next-line avoid-low-level-calls
        (bool success, bytes memory returndata) = target.call{ value: weiValue }(data);
```

```
            if (success) {
                return returndata;
            } else {
                // Look for revert reason and bubble it up if present
                if (returndata.length > 0) {
                    // The easiest way to bubble the revert reason is using memory via assembly

                    // solhint-disable-next-line no-inline-assembly
                    assembly {
                        let returndata_size := mload(returndata)
                        revert(add(32, returndata), returndata_size)
                    }
                } else {
                    revert(errorMessage);
                }
            }
        }
}

/**
 * @title SafeERC20
 * @dev Wrappers around ERC20 operations that throw on failure (when the token
 * contract returns false). Tokens that return no value (and instead revert or
 * throw on failure) are also supported, non-reverting calls are assumed to be
 * successful.
 * To use this library you can add a `using SafeERC20 for IERC20;` statement to your contract,
 * which allows you to call the safe operations as `token.safeTransfer(...)`, etc.
 */
library SafeERC20 {
    using SafeMath for uint256;
    using Address for address;

    function safeTransfer(IERC20 token, address to, uint256 value) internal {
        _callOptionalReturn(token, abi.encodeWithSelector(token.transfer.selector, to, value));
    }

    function safeTransferFrom(IERC20 token, address from, address to, uint256 value) internal {
        _callOptionalReturn(token, abi.encodeWithSelector(token.transferFrom.selector, from, to, value));
    }

    /**
     * @dev Deprecated. This function has issues similar to the ones found in
     * {IERC20-approve}, and its usage is discouraged.
     *
     * Whenever possible, use {safeIncreaseAllowance} and
     * {safeDecreaseAllowance} instead.
     */
    function safeApprove(IERC20 token, address spender, uint256 value) internal {
        // safeApprove should only be called when setting an initial allowance,
        // or when resetting it to zero. To increase and decrease it, use
        // 'safeIncreaseAllowance' and 'safeDecreaseAllowance'
        // solhint-disable-next-line max-line-length
        require((value == 0) || (token.allowance(address(this), spender) == 0),
            "SafeERC20: approve from non-zero to non-zero allowance"
        );
        _callOptionalReturn(token, abi.encodeWithSelector(token.approve.selector, spender, value));
    }

    function safeIncreaseAllowance(IERC20 token, address spender, uint256 value) internal {
        uint256 newAllowance = token.allowance(address(this), spender).add(value);
        _callOptionalReturn(token, abi.encodeWithSelector(token.approve.selector, spender, newAllowance));
    }

    function safeDecreaseAllowance(IERC20 token, address spender, uint256 value) internal {
        uint256 newAllowance = token.allowance(address(this), spender).sub(value, "SafeERC20: decreased
allowance below zero");
        _callOptionalReturn(token, abi.encodeWithSelector(token.approve.selector, spender, newAllowance));
    }

    /**
     * @dev Imitates a Solidity high-level call (i.e. a regular function call to a contract), relaxing the requirement
     * on the return value: the return value is optional (but if data is returned, it must not be false).
     * @param token The token targeted by the call.
     * @param data The call data (encoded using abi.encode or one of its variants).
     */
    function _callOptionalReturn(IERC20 token, bytes memory data) private {
        // We need to perform a low level call here, to bypass Solidity's return data size checking mechanism, since
        // we're implementing it ourselves. We use {Address.functionCall} to perform this call, which verifies that
        // the target address contains contract code and also asserts for success in the low-level call.

        bytes memory returndata = address(token).functionCall(data, "SafeERC20: low-level call failed");
        if (returndata.length > 0) { // Return data is optional
            // solhint-disable-next-line max-line-length
            require(abi.decode(returndata, (bool)), "SafeERC20: ERC20 operation did not succeed");
        }
    }
}
```

```
/**
 * @dev Library for managing
 * https://en.wikipedia.org/wiki/Set_(abstract_data_type)[sets] of primitive
 * types.
 *
 * Sets have the following properties:
 *
 * - Elements are added, removed, and checked for existence in constant time
 * (O(1)).
 * - Elements are enumerated in O(n). No guarantees are made on the ordering.
 *
 * ```
 * contract Example {
 *         // Add the library methods
 *         using EnumerableSet for EnumerableSet.AddressSet;
 *
 *         // Declare a set state variable
 *         EnumerableSet.AddressSet private mySet;
 * }
 * ```
 *
 * As of v3.0.0, only sets of type `address` (`AddressSet`) and `uint256`
 * (`UintSet`) are supported.
 */
library EnumerableSet {
        // To implement this library for multiple types with as little code
        // repetition as possible, we write it in terms of a generic Set type with
        // bytes32 values.
        // The Set implementation uses private functions, and user-facing
        // implementations (such as AddressSet) are just wrappers around the
        // underlying Set.
        // This means that we can only create new EnumerableSets for types that fit
        // in bytes32.

        struct Set {
                // Storage of set values
                bytes32[] _values;

                // Position of the value in the `values` array, plus 1 because index 0
                // means a value is not in the set.
                mapping (bytes32 => uint256) _indexes;
        }

        /**
         * @dev Add a value to a set. O(1).
         *
         * Returns true if the value was added to the set, that is if it was not
         * already present.
         */
        function _add(Set storage set, bytes32 value) private returns (bool) {
                if (!_contains(set, value)) {
                        set._values.push(value);
                        // The value is stored at length-1, but we add 1 to all indexes
                        // and use 0 as a sentinel value
                        set._indexes[value] = set._values.length;
                        return true;
                } else {
                        return false;
                }
        }

        /**
         * @dev Removes a value from a set. O(1).
         *
         * Returns true if the value was removed from the set, that is if it was
         * present.
         */
        function _remove(Set storage set, bytes32 value) private returns (bool) {
                // We read and store the value's index to prevent multiple reads from the same storage slot
                uint256 valueIndex = set._indexes[value];

                if (valueIndex != 0) { // Equivalent to contains(set, value)
                        // To delete an element from the _values array in O(1), we swap the element to delete with the last
one in
                        // the array, and then remove the last element (sometimes called as 'swap and pop').
                        // This modifies the order of the array, as noted in {at}.

                        uint256 toDeleteIndex = valueIndex - 1;
                        uint256 lastIndex = set._values.length - 1;

                        // When the value to delete is the last one, the swap operation is unnecessary. However, since this
occurs
                        // so rarely, we still do the swap anyway to avoid the gas cost of adding an 'if' statement.

                        bytes32 lastvalue = set._values[lastIndex];
```

```
            // Move the last value to the index where the value to delete is
            set._values[toDeleteIndex] = lastvalue;
            // Update the index for the moved value
            set._indexes[lastvalue] = toDeleteIndex + 1; // All indexes are 1-based

            // Delete the slot where the moved value was stored
            set._values.pop();

            // Delete the index for the deleted slot
            delete set._indexes[value];

            return true;
        } else {
            return false;
        }
}

/**
 * @dev Returns true if the value is in the set. O(1).
 */
function _contains(Set storage set, bytes32 value) private view returns (bool) {
        return set._indexes[value] != 0;
}

/**
 * @dev Returns the number of values on the set. O(1).
 */
function _length(Set storage set) private view returns (uint256) {
        return set._values.length;
}

/**
 * @dev Returns the value stored at position `index` in the set. O(1).
 *
 * Note that there are no guarantees on the ordering of values inside the
 * array, and it may change when more values are added or removed.
 *
 * Requirements:
 *
 * - `index` must be strictly less than {length}.
 */
function _at(Set storage set, uint256 index) private view returns (bytes32) {
        require(set._values.length > index, "EnumerableSet: index out of bounds");
        return set._values[index];
}

// AddressSet

struct AddressSet {
        Set _inner;
}

/**
 * @dev Add a value to a set. O(1).
 *
 * Returns true if the value was added to the set, that is if it was not
 * already present.
 */
function add(AddressSet storage set, address value) internal returns (bool) {
        return _add(set._inner, bytes32(uint256(value)));
}

/**
 * @dev Removes a value from a set. O(1).
 *
 * Returns true if the value was removed from the set, that is if it was
 * present.
 */
function remove(AddressSet storage set, address value) internal returns (bool) {
        return _remove(set._inner, bytes32(uint256(value)));
}

/**
 * @dev Returns true if the value is in the set. O(1).
 */
function contains(AddressSet storage set, address value) internal view returns (bool) {
        return _contains(set._inner, bytes32(uint256(value)));
}

/**
 * @dev Returns the number of values in the set. O(1).
 */
function length(AddressSet storage set) internal view returns (uint256) {
        return _length(set._inner);
}
```

```
    /**
     * @dev Returns the value stored at position `index` in the set. O(1).
     *
     * Note that there are no guarantees on the ordering of values inside the
     * array, and it may change when more values are added or removed.
     *
     * Requirements:
     *
     * - `index` must be strictly less than {length}.
     */
    function at(AddressSet storage set, uint256 index) internal view returns (address) {
        return address(uint256(_at(set._inner, index)));
    }


    // UintSet

    struct UintSet {
        Set _inner;
    }

    /**
     * @dev Add a value to a set. O(1).
     *
     * Returns true if the value was added to the set, that is if it was not
     * already present.
     */
    function add(UintSet storage set, uint256 value) internal returns (bool) {
        return _add(set._inner, bytes32(value));
    }

    /**
     * @dev Removes a value from a set. O(1).
     *
     * Returns true if the value was removed from the set, that is if it was
     * present.
     */
    function remove(UintSet storage set, uint256 value) internal returns (bool) {
        return _remove(set._inner, bytes32(value));
    }

    /**
     * @dev Returns true if the value is in the set. O(1).
     */
    function contains(UintSet storage set, uint256 value) internal view returns (bool) {
        return _contains(set._inner, bytes32(value));
    }

    /**
     * @dev Returns the number of values on the set. O(1).
     */
    function length(UintSet storage set) internal view returns (uint256) {
        return _length(set._inner);
    }

    /**
     * @dev Returns the value stored at position `index` in the set. O(1).
     *
     * Note that there are no guarantees on the ordering of values inside the
     * array, and it may change when more values are added or removed.
     *
     * Requirements:
     *
     * - `index` must be strictly less than {length}.
     */
    function at(UintSet storage set, uint256 index) internal view returns (uint256) {
        return uint256(_at(set._inner, index));
    }
}

/*
 * @dev Provides information about the current execution context, including the
 * sender of the transaction and its data. While these are generally available
 * via msg.sender and msg.data, they should not be accessed in such a direct
 * manner, since when dealing with GSN meta-transactions the account sending and
 * paying for execution may not be the actual sender (as far as an application
 * is concerned).
 *
 * This contract is only required for intermediate, library-like contracts.
 */
abstract contract Context {
    function _msgSender() internal view virtual returns (address payable) {
        return msg.sender;
    }

    function _msgData() internal view virtual returns (bytes memory) {
        this; // silence state mutability warning without generating bytecode - see
```

```
https://github.com/ethereum/solidity/issues/2691
        return msg.data;
    }
}

/**
 * @dev Contract module which provides a basic access control mechanism, where
 * there is an account (an owner) that can be granted exclusive access to
 * specific functions.
 *
 * By default, the owner account will be the one that deploys the contract. This
 * can later be changed with {transferOwnership}.
 *
 * This module is used through inheritance. It will make available the modifier
 * `onlyOwner`, which can be applied to your functions to restrict their use to
 * the owner.
 */
contract Ownable is Context {
    address private _owner;

    event OwnershipTransferred(address indexed previousOwner, address indexed newOwner);

    /**
     * @dev Initializes the contract setting the deployer as the initial owner.
     */
    constructor () internal {
        address msgSender = _msgSender();
        _owner = msgSender;
        emit OwnershipTransferred(address(0), msgSender);
    }

    /**
     * @dev Returns the address of the current owner.
     */
    function owner() public view returns (address) {
        return _owner;
    }

    /**
     * @dev Throws if called by any account other than the owner.
     */
    modifier onlyOwner() {
        require(_owner == _msgSender(), "Ownable: caller is not the owner");
        _;
    }

    /**
     * @dev Leaves the contract without owner. It will not be possible to call
     * `onlyOwner` functions anymore. Can only be called by the current owner.
     *
     * NOTE: Renouncing ownership will leave the contract without an owner,
     * thereby removing any functionality that is only available to the owner.
     */
    function renounceOwnership() public virtual onlyOwner {
        emit OwnershipTransferred(_owner, address(0));
        _owner = address(0);
    }

    /**
     * @dev Transfers ownership of the contract to a new account (`newOwner`).
     * Can only be called by the current owner.
     */
    function transferOwnership(address newOwner) public virtual onlyOwner {
        require(newOwner != address(0), "Ownable: new owner is the zero address");
        emit OwnershipTransferred(_owner, newOwner);
        _owner = newOwner;
    }
}


/**
 * @dev Implementation of the {IERC20} interface.
 *
 * This implementation is agnostic to the way tokens are created. This means
 * that a supply mechanism has to be added in a derived contract using {_mint}.
 * For a generic mechanism see {ERC20PresetMinterPauser}.
 *
 * TIP: For a detailed writeup see our guide
 * https://forum.zeppelin.solutions/t/how-to-implement-erc20-supply-mechanisms/226[How
 * to implement supply mechanisms].
 *
 * We have followed general OpenZeppelin guidelines: functions revert instead
 * of returning `false` on failure. This behavior is nonetheless conventional
 * and does not conflict with the expectations of ERC20 applications.
 *
 * Additionally, an {Approval} event is emitted on calls to {transferFrom}.
 * This allows applications to reconstruct the allowance for all accounts just
```

```
 * by listening to said events. Other implementations of the EIP may not emit
 * these events, as it isn't required by the specification.
 *
 * Finally, the non-standard {decreaseAllowance} and {increaseAllowance}
 * functions have been added to mitigate the well-known issues around setting
 * allowances. See {IERC20-approve}.
 */
contract ERC20 is Ownable, IERC20 {
    using SafeMath for uint256;
    using Address for address;

    mapping (address => uint256) private _balances;

    mapping (address => mapping (address => uint256)) private _allowances;

    uint256 private _totalSupply;

    string private _name;
    string private _symbol;
    uint8 private _decimals;

    /**
     * @dev Sets the values for {name} and {symbol}, initializes {decimals} with
     * a default value of 18.
     *
     * To select a different value for {decimals}, use {_setupDecimals}.
     *
     * All three of these values are immutable: they can only be set once during
     * construction.
     */
    constructor (string memory name, string memory symbol) public {
        _name = name;
        _symbol = symbol;
        _decimals = 18;
    }

    /**
     * @dev Returns the name of the token.
     */
    function name() public view returns (string memory) {
        return _name;
    }

    /**
     * @dev Returns the symbol of the token, usually a shorter version of the
     * name.
     */
    function symbol() public view returns (string memory) {
        return _symbol;
    }

    /**
     * @dev Returns the number of decimals used to get its user representation.
     * For example, if `decimals` equals `2`, a balance of `505` tokens should
     * be displayed to a user as `5,05` (`505 / 10 ** 2`).
     *
     * Tokens usually opt for a value of 18, imitating the relationship between
     * Ether and Wei. This is the value {ERC20} uses, unless {_setupDecimals} is
     * called.
     *
     * NOTE: This information is only used for _display_ purposes: it in
     * no way affects any of the arithmetic of the contract, including
     * {IERC20-balanceOf} and {IERC20-transfer}.
     */
    function decimals() public view returns (uint8) {
        return _decimals;
    }

    /**
     * @dev See {IERC20-totalSupply}.
     */
    function totalSupply() public view override returns (uint256) {
        return _totalSupply;
    }

    /**
     * @dev See {IERC20-balanceOf}.
     */
    function balanceOf(address account) public view override returns (uint256) {
        return _balances[account];
    }

    /**
     * @dev See {IERC20-transfer}.
     *
     * Requirements:
     *
```

```
     * - `recipient` cannot be the zero address.
     * - the caller must have a balance of at least `amount`.
     */
    function transfer(address recipient, uint256 amount) public virtual override returns (bool) {
        _transfer(_msgSender(), recipient, amount);
        return true;
    }

    /**
     * @dev See {IERC20-allowance}.
     */
    function allowance(address owner, address spender) public view virtual override returns (uint256) {
        return _allowances[owner][spender];
    }

    /**
     * @dev See {IERC20-approve}.
     *
     * Requirements:
     *
     * - `spender` cannot be the zero address.
     */
    function approve(address spender, uint256 amount) public virtual override returns (bool) {
        _approve(_msgSender(), spender, amount);
        return true;
    }

    /**
     * @dev See {IERC20-transferFrom}.
     *
     * Emits an {Approval} event indicating the updated allowance. This is not
     * required by the EIP. See the note at the beginning of {ERC20};
     *
     * Requirements:
     * - `sender` and `recipient` cannot be the zero address.
     * - `sender` must have a balance of at least `amount`.
     * - the caller must have allowance for ``sender``'s tokens of at least
     * `amount`.
     */
    function transferFrom(address sender, address recipient, uint256 amount) public virtual override returns (bool)
{
        _transfer(sender, recipient, amount);
        _approve(sender, _msgSender(), _allowances[sender][_msgSender()].sub(amount, "ERC20: transfer
amount exceeds allowance"));
        return true;
    }

    /**
     * @dev Atomically increases the allowance granted to `spender` by the caller.
     *
     * This is an alternative to {approve} that can be used as a mitigation for
     * problems described in {IERC20-approve}.
     *
     * Emits an {Approval} event indicating the updated allowance.
     *
     * Requirements:
     *
     * - `spender` cannot be the zero address.
     */
    function increaseAllowance(address spender, uint256 addedValue) public virtual returns (bool) {
        _approve(_msgSender(), spender, _allowances[_msgSender()][spender].add(addedValue));
        return true;
    }

    /**
     * @dev Atomically decreases the allowance granted to `spender` by the caller.
     *
     * This is an alternative to {approve} that can be used as a mitigation for
     * problems described in {IERC20-approve}.
     *
     * Emits an {Approval} event indicating the updated allowance.
     *
     * Requirements:
     *
     * - `spender` cannot be the zero address.
     * - `spender` must have allowance for the caller of at least
     * `subtractedValue`.
     */
    function decreaseAllowance(address spender, uint256 subtractedValue) public virtual returns (bool) {
        _approve(_msgSender(), spender, _allowances[_msgSender()][spender].sub(subtractedValue, "ERC20:
decreased allowance below zero"));
        return true;
    }

    /**
     * @dev Moves tokens `amount` from `sender` to `recipient`.
     *
```

```
     * This is internal function is equivalent to {transfer}, and can be used to
     * e.g. implement automatic token fees, slashing mechanisms, etc.
     *
     * Emits a {Transfer} event.
     *
     * Requirements:
     *
     * - `sender` cannot be the zero address.
     * - `recipient` cannot be the zero address.
     * - `sender` must have a balance of at least `amount`.
     */
    function _transfer(address sender, address recipient, uint256 amount) internal virtual {
        require(sender != address(0), "ERC20: transfer from the zero address");
        require(recipient != address(0), "ERC20: transfer to the zero address");

        _beforeTokenTransfer(sender, recipient, amount);

        _balances[sender] = _balances[sender].sub(amount, "ERC20: transfer amount exceeds balance");
        _balances[recipient] = _balances[recipient].add(amount);
        emit Transfer(sender, recipient, amount);
    }

    /** @dev Creates `amount` tokens and assigns them to `account`, increasing
     * the total supply.
     *
     * Emits a {Transfer} event with `from` set to the zero address.
     *
     * Requirements
     *
     * - `to` cannot be the zero address.
     */
    function _mint(address account, uint256 amount) internal virtual {
        require(account != address(0), "ERC20: mint to the zero address");

        _beforeTokenTransfer(address(0), account, amount);

        _totalSupply = _totalSupply.add(amount);
        _balances[account] = _balances[account].add(amount);
        emit Transfer(address(0), account, amount);
    }

    /**
     * @dev Destroys `amount` tokens from `account`, reducing the
     * total supply.
     *
     * Emits a {Transfer} event with `to` set to the zero address.
     *
     * Requirements
     *
     * - `account` cannot be the zero address.
     * - `account` must have at least `amount` tokens.
     */
    function _burn(address account, uint256 amount) internal virtual {
        require(account != address(0), "ERC20: burn from the zero address");

        _beforeTokenTransfer(account, address(0), amount);

        _balances[account] = _balances[account].sub(amount, "ERC20: burn amount exceeds balance");
        _totalSupply = _totalSupply.sub(amount);
        emit Transfer(account, address(0), amount);
    }

    /**
     * @dev Sets `amount` as the allowance of `spender` over the `owner`s tokens.
     *
     * This is internal function is equivalent to `approve`, and can be used to
     * e.g. set automatic allowances for certain subsystems, etc.
     *
     * Emits an {Approval} event.
     *
     * Requirements:
     *
     * - `owner` cannot be the zero address.
     * - `spender` cannot be the zero address.
     */
    function _approve(address owner, address spender, uint256 amount) internal virtual {
        require(owner != address(0), "ERC20: approve from the zero address");
        require(spender != address(0), "ERC20: approve to the zero address"); //knownsec//此处存在事务顺序依赖风险,建议添加下面的语句进行判断
        //require((amount == 0) || (_allowed[owner][spender] == 0));
        _allowances[owner][spender] = amount;
        emit Approval(owner, spender, amount);
    }

    /**
     * @dev Sets {decimals} to a value other than the default one of 18.
     *
```

```
     * WARNING: This function should only be called from the constructor. Most
     * applications that interact with token contracts will not expect
     * {decimals} to ever change, and may work incorrectly if it does.
     */
    function _setupDecimals(uint8 decimals_) internal {
        _decimals = decimals_;
    }

    /**
     * @dev Hook that is called before any transfer of tokens. This includes
     * minting and burning.
     *
     * Calling conditions:
     *
     * - when `from` and `to` are both non-zero, `amount` of ``from``'s tokens
     * will be to transferred to `to`.
     * - when `from` is zero, `amount` tokens will be minted for `to`.
     * - when `to` is zero, `amount` of ``from``'s tokens will be burned.
     * - `from` and `to` are never both zero.
     *
     * To learn more about hooks, head to xref:ROOT:extending-contracts.adoc#using-hooks[Using Hooks].
     */
    function _beforeTokenTransfer(address from, address to, uint256 amount) internal virtual { }
}

contract GFVToken is ERC20("Galaxy Finance Value", "GFV") {

    // minter list
    mapping(address => uint256) public minters;

    // transfer list
    mapping(address => uint256) public transfers;

    modifier onlyMinter() {
        require(minters[_msgSender()] == 1, "Minter: caller is not in the minter list");
        _;
    }

    modifier onlyTransfer() {
        require(transfers[_msgSender()] == 1, "Transfer: caller is not in the trasnfer list");
        _;
    }

    function addMinter(address _minter) external onlyOwner {
        if(minters[_minter] == 0) {
            minters[_minter] = 1;
        }
    }

    function removeMinter(address _minter) external onlyOwner {
        if(minters[_minter] == 1) {
            minters[_minter] = 0;
        }
    }

    function mint(address _account,uint256 _amount) public onlyMinter {
        require(_amount > 0);
        _mint(_account, _amount);
    }


    function burn(address _account,uint256 _amount) public onlyMinter {
        require(_amount > 0);
        _burn(_account, _amount);
    }


    function addTransfer(address _transfer) external onlyOwner {
        if(transfers[_transfer] == 0) {
            transfers[_transfer] = 1;
        }
    }

    function removeTransfer(address _transfer) external onlyOwner {
        if(transfers[_transfer] == 1) {
            transfers[_transfer] = 0;
        }
    }

    function transfer(address recipient, uint256 amount) public onlyTransfer() override returns (bool) {
        _transfer(_msgSender(), recipient, amount);
        return true;
    }

    function transferFrom(address sender, address recipient, uint256 amount) public onlyTransfer() override
returns (bool) {
        return super.transferFrom(sender, recipient, amount);
```

```
    }
}
```

SegmentPowerStrategy.sol

```
// File: @openzeppelin/contracts/math/SafeMath.sol

pragma solidity ^0.6.0;

/**
 * @dev Wrappers over Solidity's arithmetic operations with added overflow
 * checks.
 *
 * Arithmetic operations in Solidity wrap on overflow. This can easily result
 * in bugs, because programmers usually assume that an overflow raises an
 * error, which is the standard behavior in high level programming languages.
 * `SafeMath` restores this intuition by reverting the transaction when an
 * operation overflows.
 *
 * Using this library instead of the unchecked operations eliminates an entire
 * class of bugs, so it's recommended to use it always.
 */
library SafeMath {
    /**
     * @dev Returns the addition of two unsigned integers, reverting on
     * overflow.
     *
     * Counterpart to Solidity's `+` operator.
     *
     * Requirements:
     * - Addition cannot overflow.
     */
    function add(uint256 a, uint256 b) internal pure returns (uint256) {
        uint256 c = a + b;
        require(c >= a, "SafeMath: addition overflow");

        return c;
    }

    /**
     * @dev Returns the subtraction of two unsigned integers, reverting on
     * overflow (when the result is negative).
     *
     * Counterpart to Solidity's `-` operator.
     *
     * Requirements:
     * - Subtraction cannot overflow.
     */
    function sub(uint256 a, uint256 b) internal pure returns (uint256) {
        return sub(a, b, "SafeMath: subtraction overflow");
    }

    /**
     * @dev Returns the subtraction of two unsigned integers, reverting with custom message on
     * overflow (when the result is negative).
     *
     * Counterpart to Solidity's `-` operator.
     *
     * Requirements:
     * - Subtraction cannot overflow.
     *
     * _Available since v2.4.0._
     */
    function sub(uint256 a, uint256 b, string memory errorMessage) internal pure returns (uint256) {
        require(b <= a, errorMessage);
        uint256 c = a - b;

        return c;
    }

    /**
     * @dev Returns the multiplication of two unsigned integers, reverting on
     * overflow.
     *
     * Counterpart to Solidity's `*` operator.
     *
     * Requirements:
     * - Multiplication cannot overflow.
     */
    function mul(uint256 a, uint256 b) internal pure returns (uint256) {
        // Gas optimization: this is cheaper than requiring 'a' not being zero, but the
        // benefit is lost if 'b' is also tested.
        // See: https://github.com/OpenZeppelin/openzeppelin-contracts/pull/522
```

```
        if (a == 0) {
            return 0;
        }

        uint256 c = a * b;
        require(c / a == b, "SafeMath: multiplication overflow");

        return c;
    }

    /**
     * @dev Returns the integer division of two unsigned integers. Reverts on
     * division by zero. The result is rounded towards zero.
     *
     * Counterpart to Solidity's `/` operator. Note: this function uses a
     * `revert` opcode (which leaves remaining gas untouched) while Solidity
     * uses an invalid opcode to revert (consuming all remaining gas).
     *
     * Requirements:
     * - The divisor cannot be zero.
     */
    function div(uint256 a, uint256 b) internal pure returns (uint256) {
        return div(a, b, "SafeMath: division by zero");
    }

    /**
     * @dev Returns the integer division of two unsigned integers. Reverts with custom message on
     * division by zero. The result is rounded towards zero.
     *
     * Counterpart to Solidity's `/` operator. Note: this function uses a
     * `revert` opcode (which leaves remaining gas untouched) while Solidity
     * uses an invalid opcode to revert (consuming all remaining gas).
     *
     * Requirements:
     * - The divisor cannot be zero.
     *
     * _Available since v2.4.0._
     */
    function div(uint256 a, uint256 b, string memory errorMessage) internal pure returns (uint256) {
        // Solidity only automatically asserts when dividing by 0
        require(b > 0, errorMessage);
        uint256 c = a / b;
        // assert(a == b * c + a % b); // There is no case in which this doesn't hold

        return c;
    }

    /**
     * @dev Returns the remainder of dividing two unsigned integers. (unsigned integer modulo),
     * Reverts when dividing by zero.
     *
     * Counterpart to Solidity's `%` operator. This function uses a `revert`
     * opcode (which leaves remaining gas untouched) while Solidity uses an
     * invalid opcode to revert (consuming all remaining gas).
     *
     * Requirements:
     * - The divisor cannot be zero.
     */
    function mod(uint256 a, uint256 b) internal pure returns (uint256) {
        return mod(a, b, "SafeMath: modulo by zero");
    }

    /**
     * @dev Returns the remainder of dividing two unsigned integers. (unsigned integer modulo),
     * Reverts with custom message when dividing by zero.
     *
     * Counterpart to Solidity's `%` operator. This function uses a `revert`
     * opcode (which leaves remaining gas untouched) while Solidity uses an
     * invalid opcode to revert (consuming all remaining gas).
     *
     * Requirements:
     * - The divisor cannot be zero.
     *
     * _Available since v2.4.0._
     */
    function mod(uint256 a, uint256 b, string memory errorMessage) internal pure returns (uint256) {
        require(b != 0, errorMessage);
        return a % b;
    }
}

contract Governance {

    address public _governance;

    constructor() public {
```

```
        _governance = tx.origin;
    }

    event GovernanceTransferred(address indexed previousOwner, address indexed newOwner);

    modifier onlyGovernance {
        require(msg.sender == _governance, "not governance");
        _;
    }

    function setGovernance(address governance)    public    onlyGovernance
    {
        require(governance != address(0), "new governance the zero address");
        emit GovernanceTransferred(_governance, governance);
        _governance = governance;
    }


}

contract SegmentPowerStrategy is Governance {
    using SafeMath for uint256;
    ////
    struct degoSegment {
        uint256 min;
        uint256 max;
    }
    struct countSegment {
        uint32 length;
        uint32 curCount;
    }
    struct playerInfo {
        uint256 amount;
        uint8 segIndex;
        uint32 playerId;
        uint32 offset;
    }

    mapping(address => uint32) public _addressXId;
    mapping(uint8 => degoSegment) public _degoSegment;
    mapping(uint8 => countSegment) public _countSegment;
    mapping(uint8 => mapping(uint32 => uint32)) public _playerIds;
    mapping(uint32 => playerInfo) public _playerMap;

    uint8[3] public _ruler = [8, 1, 1];
    uint8[3] public _factor = [2, 4, 1];

    uint8 public _high = 3;
    uint8 public _mid = 2;
    uint8 public _low = 1;

    uint32 public _playerId = 0;
    uint32 public _base = 100;
    uint32 public _anchor = _base;
    uint32 public _grouthCondition = 100;
    uint32 public _grouthStep = 10;
    uint32 constant public _highMax = 50;
    uint32 constant public _midMax = 50;

    uint256 constant public    _initMaxValue = 500 * (10**18);    //500lp,10w usdt,100 eth

    address public _contractCaller = address(0x0);

    /**
     * check pool
     */
    modifier isNormalPool(){
        require( msg.sender==_contractCaller,"invalid pool address!");
        _;
    }

    constructor()
    public
    {
        _playerId = 0;

        initSegment();
        updateRuler(_initMaxValue);
    }

    function lpIn(address sender, uint256 amount)
    isNormalPool()
    external {

        uint32 playerId = _addressXId[sender];
        if ( playerId > 0 ) {
            _playerMap[playerId].amount = _playerMap[playerId].amount.add(amount);
```

```
        } else {
            //new addr
            _playerId = _playerId+1;
            _addressXId[sender] = _playerId;

            playerId = _playerId;
            _playerMap[playerId].playerId = playerId;
            _playerMap[playerId].amount = amount;
            _playerMap[playerId].segIndex = 0;
            _playerMap[playerId].offset =  0;

            //update segment
            updateSegment();
        }

        settlePowerData(playerId);
    }

    function lpOut(address sender, uint256 amount)
    isNormalPool()
    external{
        uint32 playerId = _addressXId[sender];
        if ( playerId > 0 ) {//knownsec//池子中不存在该用户的信息，不允许取出
            _playerMap[playerId].amount = _playerMap[playerId].amount.sub(amount);
        } else {
            return;
        }

        settlePowerData(playerId);
    }

    function getPower(address sender)
    view external
    returns (uint256) {

        uint32 playerId = _addressXId[sender];
        if ( playerId > 0 ) {
            uint8 segment = _playerMap[playerId].segIndex;
            if(segment>0){
                return uint256(_factor[segment-1]).mul(_playerMap[playerId].amount);
            }
        }

        return 0;
    }


    function setCaller( address caller ) public  onlyGovernance{
        _contractCaller = caller;
    }

    function updateRuler( uint256 maxCount ) internal{

        uint256 lastBegin = 0;
        uint256 lastEnd = 0;
        uint256 splitPoint = 0;
        for (uint8 i = 1; i <= _ruler.length; i++) {
            splitPoint = maxCount * _ruler[i - 1]/10;
            if (splitPoint <= 0) {
                splitPoint = 1;
            }
            lastEnd = lastBegin + splitPoint;
            if (i == _ruler.length) {
                lastEnd = maxCount;
            }
            _degoSegment[i].min = lastBegin + 1;
            _degoSegment[i].max = lastEnd;
            lastBegin = lastEnd;
        }
    }

    function initSegment() internal {

        _countSegment[_low].length = 80;
        _countSegment[_mid].length = 10;
        _countSegment[_high].length = 10;

        _countSegment[_low].curCount = 0;
        _countSegment[_mid].curCount = 0;
        _countSegment[_high].curCount = 0;
    }

    function updateSegment( ) internal {

        if (_playerId >= _grouthCondition+_anchor ) {
            if (_countSegment[_high].length + _grouthStep > _highMax) {
                _countSegment[_high].length = _highMax;
```

```
            } else {
                _countSegment[_high].length = _countSegment[_high].length+_grouthStep;
            }

            if (_countSegment[_mid].length + _grouthStep > _midMax) {
                _countSegment[_mid].length = _midMax;
            } else {
                _countSegment[_mid].length = _countSegment[_mid].length+_grouthStep;
            }
            _anchor = _playerId;
        }
    }

    function hasCountSegmentSlot(uint8 segIndex) internal view returns (bool){
        uint32 value = _countSegment[segIndex].length-_countSegment[segIndex].curCount;
        if (value > 0) {
            return true;
        } else {
            return false;
        }
    }

    function findSegmentMinPlayer(uint8 segIndex) internal view returns (uint32,uint256){
        uint256 firstMinAmount = _degoSegment[segIndex].max;
        uint256 secondMinAmount = _degoSegment[segIndex].max;
        uint32 minPlayerOffset = 0;
        for (uint8 i = 0; i < _countSegment[segIndex].curCount; i++) {
            uint32 playerId = _playerIds[segIndex][i];
            if( playerId==0 ){
                continue;
            }
            uint256 amount = _playerMap[playerId].amount;

            //find min amount;
            if ( amount < firstMinAmount) {
                if (firstMinAmount < secondMinAmount) {
                    secondMinAmount = firstMinAmount;
                }
                firstMinAmount = amount;
                minPlayerOffset = i;
            }else{
                //find second min amount
                if(amount < secondMinAmount ){
                    secondMinAmount = amount;
                }
            }
        }

        return (minPlayerOffset,secondMinAmount);
    }

    //swap the player data from old segment to the new segment
    function segmentSwap(uint32 playerId, uint8 segIndex) internal {

        uint8 oldSegIndex = _playerMap[playerId].segIndex;

        uint32 oldOffset = _playerMap[playerId].offset;
        uint32 tail = _countSegment[segIndex].curCount;

        _playerMap[playerId].segIndex = segIndex;
        _playerMap[playerId].offset = tail;

        _countSegment[segIndex].curCount = _countSegment[segIndex].curCount+1;
        _playerIds[segIndex][tail] = playerId;

        if (oldSegIndex>0 && segIndex != oldSegIndex && _playerIds[oldSegIndex][oldOffset] > 0) {

            uint32 originTail = _countSegment[oldSegIndex].curCount-1;
            uint32 originTailPlayer = _playerIds[oldSegIndex][originTail];

            if(originTailPlayer != playerId){

                _playerMap[originTailPlayer].segIndex = oldSegIndex;
                _playerMap[originTailPlayer].offset = oldOffset;
                _playerIds[oldSegIndex][oldOffset] = originTailPlayer;
            }

            _playerIds[oldSegIndex][originTail] = 0;
            _countSegment[oldSegIndex].curCount = _countSegment[oldSegIndex].curCount-1;
        }
    }

    //swap the player data with tail
    function tailSwap( uint8 segIndex) internal returns (uint32){

        uint32 minPlayerOffset;
        uint256 secondMinAmount;
```

```
        (minPlayerOffset,secondMinAmount) = findSegmentMinPlayer(segIndex);
        _degoSegment[segIndex].min = secondMinAmount;

        uint32 leftPlayerId = _playerIds[segIndex][minPlayerOffset];

        //segmentSwap to reset
        uint32 tail = _countSegment[segIndex].curCount - 1;
        uint32 tailPlayerId = _playerIds[segIndex][tail];
        _playerIds[segIndex][minPlayerOffset] = tailPlayerId;

        _playerMap[tailPlayerId].offset = minPlayerOffset;

        return leftPlayerId;
    }

    function joinHigh(uint32 playerId) internal {
        uint8 segIndex = _high;
        if (hasCountSegmentSlot(segIndex)) {
            segmentSwap(playerId, segIndex);
        } else {
            uint32 leftPlayerId = tailSwap(segIndex);
            joinMid(leftPlayerId);
            segmentSwap(playerId, segIndex);

        }
    }

    function joinMid(uint32 playerId) internal {
        uint8 segIndex = _mid;
        if (hasCountSegmentSlot(segIndex)) {
            segmentSwap(playerId, segIndex);
        } else {
            uint32 leftPlayerId = tailSwap(segIndex);
            joinLow(leftPlayerId);
            segmentSwap(playerId, segIndex);
        }
        _degoSegment[segIndex].max = _degoSegment[segIndex + 1].min;
    }

    function joinLow(uint32 playerId) internal {

        uint8 segIndex = _low;
        segmentSwap(playerId, segIndex);
        _degoSegment[segIndex].max = _degoSegment[segIndex + 1].min;
        // low segment length update
        if( _countSegment[segIndex].curCount > _countSegment[segIndex].length){
            _countSegment[segIndex].length = _countSegment[segIndex].curCount;
        }
    }

    function settlePowerData(uint32 playerId) internal {

        uint256 amount = _playerMap[playerId].amount;
        uint8 segIndex = 0;
        for (uint8 i = 1; i <= _high; i++) {
            if (amount < _degoSegment[i].max) {
                segIndex = i;
                break;
            }
        }
        if (segIndex == 0) {
            _degoSegment[_high].max = amount;
            segIndex = _high;
        }

        if (_playerMap[playerId].segIndex == segIndex) {
            return;
        }

        if (segIndex == _high) {
            joinHigh(playerId);
        } else if (segIndex == _mid) {
            joinMid(playerId);
        } else {
            joinLow(playerId);
        }
    }
}
```

6. Appendix B: Vulnerability rating standard

Smart contract vulnerability rating standards	
Level	Level Description
High	Vulnerabilities that can directly cause the loss of token contracts or user funds, such as: value overflow loopholes that can cause the value of tokens to zero, fake recharge loopholes that can cause exchanges to lose tokens, and can cause contract accounts to lose BNB or tokens. Access loopholes, etc.; Vulnerabilities that can cause loss of ownership of token contracts, such as: access control defects of key functions, call injection leading to bypassing of access control of key functions, etc.; Vulnerabilities that can cause the token contract to not work properly, such as: denial of service vulnerability caused by sending BNB to malicious addresses, and denial of service vulnerability caused by exhaustion of gas.
Medium	High-risk vulnerabilities that require specific addresses to trigger, such as value overflow vulnerabilities that can be triggered by token contract owners; access control defects for non-critical functions, and logical design defects that cannot cause direct capital losses, etc.
Low	Vulnerabilities that are difficult to be triggered, vulnerabilities with limited damage after triggering, such as value overflow vulnerabilities that require a large amount of BNB or tokens to trigger, vulnerabilities where attackers cannot

	directly profit after triggering value overflow, and the transaction sequence triggered by specifying high gas depends on the risk Wait.

7. Appendix C：Introduction to auditing tools

7.1 Manticore

Manticore is a symbolic execution tool for analyzing binary files and smart contracts. Manticore includes a symbolic Ethereum Virtual Machine (EVM), an EVM disassembler/assembler and a convenient interface for automatic compilation and analysis of Solidity. It also integrates Ethersplay, Bit of Traits of Bits visual disassembler for EVM bytecode, used for visual analysis. Like binary files, Manticore provides a simple command line interface and a Python for analyzing EVM bytecode API.

7.2 Oyente

Oyente is a smart contract analysis tool. Oyente can be used to detect common bugs in smart contracts, such as reentrancy, transaction sequencing dependencies, etc. More convenient, Oyente's design is modular, so this allows advanced users to implement and Insert their own detection logic to check the custom attributes in their contract.

7.3 securify.sh

Securify can verify common security issues of Ethereum smart contracts, such as disordered transactions and lack of input verification. It analyzes all possible execution paths of the program while fully automated. In addition, Securify also has a

specific language for specifying vulnerabilities, which makes Securify can keep an eye on current security and other reliability issues at any time.

7.4 Echidna

Echidna is a Haskell library designed for fuzzing EVM code.

7.5 MAIAN

MAIAN is an automated tool for finding vulnerabilities in Ethereum smart contracts. Maian processes the bytecode of the contract and tries to establish a series of transactions to find and confirm the error.

7.6 ethersplay

ethersplay is an EVM disassembler, which contains relevant analysis tools.

7.7 ida-evm

ida-evm is an IDA processor module for the Ethereum Virtual Machine (EVM).

7.8 Remix-ide

ida-evm is an IDA processor module for the Ethereum Virtual Machine (EVM).

7.9 Knownsec Penetration Tester Special Toolkit

Pen-Tester tools collection is created by KnownSec team. It contains plenty of Pen-Testing tools such as automatic testing tool, scripting tool, Self-developed tools etc.

KNOWNSEC

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